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THE AGRICULTURAL ANT.*

BY DR. G. LINCECUM.

Since my return from Mexico, I have discovered several traits in the character of the *Myrmica molefaciens* that I had not noticed before. In fact, the circumstances that have developed the facts I am about to notice had not transpired.

In 1848, the year I came to Long Point, there was but one agricultural ant city within a mile of the place. This nest was situated in a nearly barren little spot on top of an elevation, underlaid with stratified sandstone. Here there was but little grass and weeds to interfere with their seed collecting labors. The ant rice which they so carefully cultivate was flourishing in a regular circle near the outer border, but inside of the pavement. There were little patches of the same grass scattered about on the little glade which had doubtless been planted there by some experienced ant, for it had been neatly cleared of all other vegetables, in fact cultivated by them.

The entire surrounding country consists of very rich black prairie soil, and was bearing a very heavy coat of cowfodder grasses. In this dense coat of grass the mound builder could not travel; but was content to confine himself to a single city in the open district, until a road that passed near the pavement had been tramped out through the deep grass. This occurred about two

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years after my first acquaintance with the above named city. It was interesting to observe how soon they availed themselves of the use of the clean hard-trodden road. They were seen running along in trains half a mile from their city, and it was not long before new cities were seen along the side of the road. The first one made its appearance about eighty yards from the old city and just far enough from the road to be out of the way of the passing teams.

These new cities, which, in the course of three years, made their appearance at intervals of about eighty yards along the side of the road for more than a mile, were never seen before; they were a year and a half old. One of their peculiarities is, that with bits of stick, little balls of soil and the like, they conceal the entrance of a new city until they consider themselves sufficiently strong to make their appearance and sustain themselves among the nests of other ants. They are then seen clearing out and paving a considerable circular space around the entrance to their city. Some old settlements have a pavement fifteen feet in diameter and a mound in the centre a foot high.

And now the increasing cattle made the grass thinner, and the ants swarming out spread their cities in all directions at short intervals (thirty yards is about the average) until the prairies are full of them.

They do not, like the bees, throw off colonies, to go out and build up a new kingdom. It is a very different process. On a certain day in summer all the males and females—they all fly—assemble, as if by appointment, from all the surrounding nests, at some suitable place; generally in the smooth road, where they seize each other, three or four males to one female and wallowing on the ground eagerly, give the idea of a battle; which the careless observer is sure to report as such. It is, however, no battle, but a rampant amative furor, which continues three or four hours, when the female becoming satisfied with her numerous, eager lovers, makes shift to tear herself loose from them and make her escape. At first she climbs up some little weed or spear of grass, and seems to rest for a few minutes, when she spreads her glassy wings for the last time, and flies with the wind until she is tired, or till some counter current casts her to the ground. She seems now in great haste, and running around, she soon selects a place, where she energetically goes to work digging a small hole, which, when

she has deepened sufficiently for her wings to prevent her free ingress, she deliberately withdraws and with her sharp mandibles clips them off. She now continues her labors until the hole is six or seven inches deep, and excavating a small cell at the bottom, she closes the passage above, and remains sleeping in her little cell nine or ten days. If she survives that long, she comes out, procures some food and goes to work, deposits twenty or thirty eggs, raises them to maturity;—they are all workers—and after this the queen or mother ant is seen outside no more. She conceals the entrance to her kingdom, keeps her workers busy, increases their number rapidly, and in the course of eighteen months, finding her armies sufficiently strong, she throws off all disguise and clearing a considerable space around the gate of the city commences to pave it and to build up a monument or pyramid. This last is a public work as well as the pavement, and it is carried on slowly by the police, who are always found on and around the environs of the city.

Thus have I partially described the origin and progress of a single successful mother ant of the mound building species. Were all that fly away from those astonishing connubial assemblies equally successful, it would require but very few years for them to overpeople the whole earth. But nature, as she has done in all other races of animal life, has made provisions for the destruction of the superfluous queens. Great numbers of them never return from the little cell they have prepared for themselves at the bottom of their new home. They die either from having packed the dirt in the hole above them, or from being found by the hunters or soldiers of the surrounding kingdoms, whose custom it is, whenever they discover one of these new beginnings for a city, invariably to dig out and assassinate the occupant. Many birds are fond of the females of this species of ant, devouring all they can find. There are many other causes for the failure of these fat queens which, according to my observations on the subject, result in the conclusion, that not exceeding one in a thousand of those beginning a nest survives and builds up a colony.

I have witnessed several of their grand connubial festivals. One I saw in 1858, that occupied a plat of ground 107 yards in length and ten yards wide. The ground was thickly strewn with them. When I first discovered them they were coming from every direction, and lighting down on the above described plat by

tens of thousands. It was a great day with the ants; and soon the place was so completely carpeted with them that it was impossible to walk among them and not crush them.

In the course of three hours the males began to show the dreadful effects of their dissolute course. They began rapidly to die. The females would wring themselves loose from the males and fly off, leaving them exhausted and struggling in death. They had fulfilled their mission, and the ground long before night was covered with their dead bodies.

I visited the place the next morning; the wind had driven them into the little gullies in the road, and there could not have been less than a bushel of them. Not a female dead or alive to be seen anywhere amongst them. But not far off, and in the direction the wind was blowing at the time they made their escape from their prostrate and dying lovers, could be seen countless numbers of little black piles of earth which had been thrown out of their holes during the night. There were fifteen to twenty of these new burrows to every square rod, and they were seen in that proportion for more than a mile. So it is plain, if there were no counteracting influences, to see that they would soon occupy every available space. Few of them, however, proved successful, for the whole prairie had already been fully stocked with them. Pavements were to be seen every thirty or forty yards, but too new to possess any mounds. Their pavements were flat when in 1868 I went away; and now I have got back in 1873 I find they have made great improvements; all have raised mounds, some of them quite large. The progress they have made on their mounds and pavements is very conspicuous.

This species of ant subsists almost entirely on small seeds, great quantities of which they store away in their granary-cells to supply food for winter. During rainy seasons in the autumnal months it happens right often that the ground becoming saturated, the water penetrates their granaries, and swells and sprouts their seeds. In this emergency they bring out the damaged grain the first fair day, and exposing it to the sun until near night, they take in all that is not actually sprouted. I saw them in G. W. Gentrey's farm one day have out on a flat rock as much as a gallon of wheat sunning. I wanted to see how they would manage to get so much back again, and returned again that evening just in time to see their hosts come out and carry it in in five minutes.

There are many other interesting achievements performed by this sagacious race of insects. I have recently discovered a great difference in their mental operations and capacities. Individuals there are which possess great intellectual superiority to the common laboring classes, which is manifested in the fact that they assume the leadership in all their important public works and army movements. Some are much more sagacious and cautious in avoiding traps and dangerous contrivances set for them by the scarcely superior human genus.

One of our Germans invented a very destructive ant trap. It is set over the entrance to their city, and is so contrived, that going or coming it is sure to entrap them; but not all of them. Occasionally a well formed fellow is observed to arrive at the top of the precipice, where he stops and gravely and cautiously surveys the awful abyss below, filled with frantic and terribly distressed thousands—who have incautiously precipitated themselves into inevitable ruin—and after viewing the dreadful and disastrous condition of his fellow laborers, he seems to understand the true nature of the misfortune, and turning from the irremediable calamity, hastens down the inclined place into the grass weeds, beyond the reach of further observation.

Quite a number of them are seen to examine and hastily fly from the entrance of this destructive trap.

AZALEA VISCOSA, A FLY-CATCHER.

BY W. W. BAILEY.

The many curious observations published of late in regard to vegetable fly-catchers have opened my eyes to such phenomena as are presented in my forest walks. As is well known to all botanists, our sweet swamp azalea (*Azalea viscosa*) has its corolla covered on the outside with innumerable clammy and glandular hairs. Each hair is a prolongation of the cuticle and is surmounted by a purple and globular gland. In the bud, these hairs appear to cover the whole surface of the flower, but when the corolla expands, they are seen to occupy the midrib of the

petals as well as the tube of the corolla. These glandular hairs are efficacious fly-catchers, but what the object is in thus securing insect prey, I will not pretend to state.

I have been amusing myself, if any such apparently cruel occupation can be considered entertaining, in watching the capture of flies by the azaleas. When I first brought the flowers home, many small insects, as winged ants, were entrapped amidst the hairs. These have remained alive several days, still vainly struggling for freedom. As the houseflies are abundant in my room, it occurred to me that I might extirpate the pests, and at the same time learn something of the process of insect-catching. I have not noticed that the powerful fragrance of the blossoms attracts the housefly, although I have no doubt that it does the smaller insects. It seemed to be accidental when the houseflies were captured. I exposed a number of buds and fully opened blossoms on a sunny window-sill thronged with flies. It was not many minutes before I had several captures. A mere touch of a fly's leg to the glutinous hairs was sufficient for his detention. A struggle only made matters worse, as other legs were by this means brought in contact with the glands. These emit long glairy threads which fasten to the hairs of the flies' legs. They may be drawn out to a great length and tenuity, still retaining their strength. If two buds are pressed together and then drawn apart, innumerable threads may be seen to bind them. There is a complete network of them between the various glands. They will confine the strongest fly; he is at once held like Gulliver among the Liliputians. Under the microscope, the legs of the fly are seen to be covered with the secretion, which is perfectly white and transparent. In one attempt to escape, a housefly lifted a flower bodily from the window-sill, perhaps a quarter of an inch, but at once sank back exhausted amidst the hairs. One, after long efforts, escaped, but seemed incapable of using its legs; it flew away readily. In one instance, I have found the dried remains of a small insect embedded amidst the hairs, but cannot say whether its juices were in any way absorbed by the plant. If such assimilation takes place, what is its purpose? Can this phenomenon of fly-catching be in any case accidental, or is some nice purpose concealed in it? I merely state the facts as I have observed them; perhaps others can supply further information.

ON THE ANTENNÆ IN THE LEPIDOPTERA.

BY AUG. R. GROTE, A. M.

In a paper read before the Portland meeting of the American Association for the Advancement of Science, I endeavored to show that the antennæ in the moths, or night-flying Lepidoptera, were more highly specialized than in the butterflies, and that this specialization of structure was correlated with habit in these insects. I stated that the antennæ were more actively used by the moth than by the butterfly, and I suggested that their sensitiveness was a protection and an assistance to the night-flying moths in directions where a change to a diurnal habit rendered such sensitiveness less necessary to the butterfly. In two instances I was led to reject conclusions with regard to the antennæ that had already appeared in print. The first of these is the hitherto accepted and arbitrary division of the Lepidoptera into two sections under the terms Rhopalocera, or club-horned, and Heterocera or diversely-horned. I endeavored to show, that the change in the antennal form was a gradual one, from the neuropteriform antennæ of the Tineidæ, or lowest moths, to the butterfly-like antennæ of the Castniares, or highest moths; that the antennæ of the Hesperidæ were quite different from the butterflies; and that the change in antennal structure throughout the suborder was really expressed by a greater rigidity and equalization in length, or was one of direction and attitude. As the antennæ become less serviceable to the insect they become more rigid and in position more elevated above the head, as in the butterfly, while in the moth they are more whip-like and are directed forwards or, in a state of rest, frequently thrown backwards by the sides of the body, beneath the wings. The second instance is that of Dr. Clemens,* who came to the conclusion that the antennæ, in the Lepidoptera, "instead of being organs of any special sense, as they are usually regarded, are instruments of atmospheric palpation." I have endeavored to show that Dr. Clemens' experiments with the moth *Platysamia cecropia*, instead of being confirmatory of this view, point to an exactly opposite conclusion. Neither by smell nor hearing could the night-

* Journal Acad. Nat. Sci. Phil., 1859, p. 122.

flying moth, deprived of its antennæ, become sensible of direction or locality, and under its condition of mutilation it naturally refused to proceed. A very strong argument would indeed be needed to confirm the fact that in a single suborder of insects, so important and widely developed an organ as the antenna was devoted to an exceptional use, while the absence of any structural connection between the wings and the antennæ renders such a construction impossible. It appears rather that the senses of smell and hearing are not differentiated in insects and that the antennæ are organs of perception receiving impressions from either sense. The "assembling" of the Bombyces has its cause probably in the greater specialization of the male antennæ, which are sensitive to the odor of the female as well as to the waves of sound. It is not extraordinary to find such a means for the preservation of the species highly developed in a group where the maxillæ are feebly developed, little or no food is taken, and the duration of life in the reproductional stage is so brief as in the Bombyces. Having watched the free habit of the butterflies, I have thought that these depended more on the organs of vision for a recognition of the sexes, and I have detected instances of necessarily harmless coquetry between the males of Argynnis; an action not unrelated to that observable among dogs and higher animals. Professor Mayer's experiments with the male mosquito, as narrated in the AMERICAN NATURALIST, vol. 8, p. 236, are confirmatory of these views, as showing the sensitiveness of the antennæ to the waves of sound, and it is not unreasonable to suppose that the antennæ of the male insect are particularly sensitive to the peculiar sounds and odors emitted by the female of its own species.

In the absence as yet of conclusive evidence as to cases of peculiar sensitiveness to odor or sound, it may be sufficient to feel sure from what has been adduced of the general functions of the antennæ, and it has been the object of the writer to show that the point of view from which systematists have hitherto regarded the antennæ is unfertile, and to direct attention to the real differences in antennal structure between the butterflies and moths, while showing that the antennæ are modified by desuetude in the former and higher group.

THE SOCIAL LIFE OF THE LOWER ANIMALS.*

BY PROF. P. J. VAN BENEDEN.

In that great spectacle which we call nature, each animal plays a distinct rôle, and He who weighs and rules all with order cares as much for the preservation of the most repulsive insect as the propagation of the most brilliant bird.

In coming into the world each of them knows its place, and fills it the better as it is more free to obey its instinct. Each carries his prompter about with him, and man may be compared to their manager.

Over this great drama of life presides a law as harmonious as that which rules the movements of the stars; and if at each hour, death carries off from this scene myriads of beings, at each hour also life causes new legions to replace them. It is a whirlwind, a chain without end.

It is demonstrated to-day, that the animal, whatever it may be, whether that which occupies the top of the scale, or that which touches the last confines of the kingdom, consumes water and carbon. Albumen suffices for all the wants of life. The same hand, however, which has brought the world out of chaos, has varied the nature of this consummation; it has proportioned this universal nourishment to the needs and to the particular organization of the species which should draw from it the principle of motion, the maintenance of life.

It is a very interesting study, that which has for its end a knowledge of the food of each species. This study constitutes an important branch of the history of animals; the bill of fare is written in advance in indelible characters in each specific type, and these characters are scarcely less difficult to decipher for the naturalist than the palimpsest or the archæologist. It is under the form of a bone or of scales, of feathers or of shells, that these culinary letters figure in the digestive tracts. It is by visits not domiciliary but stomachal, that we are to be initiated into these details of household economy.

* Translated from La Revue Scientifique.

The bill of fare of fossil animals, though written in characters less clear and less complete, can, however, still often be read in their coprolites. We should not despair even of discovering some day the fishes and the crustacea which were devoured by the plesiosaurs and the ichthyosaurs, and of finding that some parasitic worms may have been introduced with them into their spiral cæcum.

Naturalists have not always studied with sufficient care the relations which exist between the animal and its food, though these relations would furnish the observer with information of a high importance.

Every organic body, conferva or moss, insect or mammal, becomes the prey of some beast; liquid or solid, sap or blood, horn or feather, flesh or bone, all disappear under the teeth of one or the other; and to the remains found in each correspond the instruments necessary for their assimilation. These primitive relations between animals and their diet maintain the industry of each species.

We find on taking a nearer view, more analogy between the animal world and human society, and, without seeking farther, we can say there is no social position which has not its counterpart among the animals.

The greater number of them live quietly on the fruits of their labor, and practise a trade which supports them; but aside from these honest industries, we see also certain miserable beings which cannot live without the aid of their relatives, and establish themselves, some as *parasites* in the thickness of their organs, the others as *commensals* by the side of their host.

It is some years since one of our learned and intelligent confrères of the University of Utrecht, Professor Harting, wrote a charming little book on the industry of animals. He has drawn our attention to the fact that most of the trades are perfectly known in the animal kingdom. We find indeed among them miners, masons, carpenters, paper-makers, weavers, and we may even say lace-makers, who work at first for themselves, and afterwards for their offspring. Then there are some which dig the soil, strengthen arches, clear up useless pieces of land, and like miners consolidate works;* others build huts or palaces accord-

* The Mygales among spiders, the Andrena, the mole-cricket, the ant-lion, the Arenicolæ, Terebrellæ, Sabellæ, Tubifex, etc., among the worms. There are also some

ing to all the rules of architecture;* still others know how to steal all the secrets of the makers of paper, of pasteboard,† of cloth or lace,‡ and their products have generally nothing to fear in comparison with the point lace of Malines or Brussels. Who has not admired the ingenious and cunning construction of the nests of bees and of ants, the delicate and marvellous structure of the webs of the spider?

The perfection of the tissues of some of these fabrics is even so highly appreciated that when, for his telescope, the astronomer wants a fine and delicate thread, it is not to Paris or London he sends, but to a living manufacturer, to a lowly spider! When the naturalist needs to compare the degree of perfection of his microscope, or of a micrometric measure for infinitely small beings, he consults, what? a millimetre cut and divided into a hundred or a thousand parts? No! simply a shell of a diatom,§ so small and indistinct that it has to be magnified several million times in order to be visible to the naked eye, and the best microscopes do not yet always reveal all the delicacy of designs which adorn these wonderful organisms; it is with difficulty that the instruments of the first masters suffice to observe the infinitesimal fantasies which decorate these liliputian shells.

Finally to whom do the manufacturers of Verviers or of Lyons, of Gand or of Manchester go for their first designs? To an animal, a flower; and even to the present day we have been unwilling to imitate their example. These workshops are in operation every day under our eyes, their gates are largely open to all the world,

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Mollusca, as the Pholades and Teredo, which make a submarine domicile in wood, whether stationary, or floating about. There are in like manner several mammals; the Chinchilla of Peru, the Bathyergus and the Orycteropus of the Cape of Good Hope, the marmot, the Sphermephilus and the badger, as also the small mammal known to every one, the mole.

There are also those which construct small boats which the waves never submerge; we have in fresh water the sticklebacks; and in his last voyage, L. Agassiz has drawn attention to a fish which constructs its nest in the sargasso weed. The most important discovery, says the illustrious naturalist of Cambridge, has been that of a nest built by a fish, and floating on the broad ocean, with its freight living in the middle of the sea.

* The bees and white ants, which build houses thirty feet high, wasps, etc.

† Different species of wasps, especially *Chartergus chartarius* of South America, *Polistes tepida*, *Vespa vulgaris* and *sylvestris*.

‡ Several spiders, *Epeira diadema*, *Argyronecta aquatica* and especially *Tinea sequella*, the cocoon of which was the admiration of Lyonnet. The Argyronecta constructs even a diving bell. Among the sponges, *Euplectella aspergillum*, Hyalonema and Holtenia likewise construct palaces of lace.

§ *Pleurosigma angulatum*; *Amphipleura pellucida*, etc., etc.

and none of them are marked with the hackneyed inscription — *No Admittance.*

Should these machines stop, or should they only rest for a time, we should be exposed to the chances of not being able to cover the nakedness of our shoulders; the fine lady would have no more cashmere, nor silk nor velvet; as for us, we should have no more flannels, nor cloths to cover us; the shepherd even, as also the mountaineer, would no longer have his goatskin to protect himself against the inclemency of the weather. It is by the kindness of this good creature which gives us its flesh and fleece, that we can leave the south to brave the rigor of the northern climates and establish ourselves by the side of the reindeer and narwhal among perpetual glaciers.*

We have science and steam, of which we are justly proud, but in order to manufacture their marvellous textures, the animals have only their simple instinct, and yet make them much better than we. How instructive is this parallel between the products of nature and those of man! How it lowers our pretensions!

The pretended blind forces of nature produce offspring that the genius of man may seek in vain to replace, and we would not dream of contending with these living machines which we every day crush under foot.

The greatest industry would be invariably surpassed did we place in one of our great universal expositions its products side by side with those of the insect or spider. In order to conform to the ideas of equality of this age, we should not in taking sides forget our pretended ancestors.

There are all sorts of pursuits in this world, and if some of them are honest, we can say that there are others which scarcely deserve this qualification. In the old as in the new world more than one animal is a swindler, leading the life of a fine gentleman,† and it is not rare to find by the side of the modest pickpocket,‡ the audacious brigand of the highway§ who lives by blood and carnage. The number is even as great as those rowdies of the far West who always escape, whether by some ruse, or by audacity, or by a superiority of wickedness, social punishment.

* The mouflon (*Ovis musimon*) and the bouquetan (*Capra ibex*) which have become our sheep and our goats.

† The Paguri, or Bernard the hermit (*Eupagurus bernhardus*), Cenobites and several others.

‡ The beef-eater, the starling, the kite.

§ The sharks generally.

But among these independent existences there are a certain number, who, without being parasites, cannot live without aid, and who claim from their relations, sometimes a simple resting place at the same table to divide the meal of the day; we daily discover some which pass as parasites, but which, however, do not live in any other way at the expense of their host.

Although a copepod crustacean is installed in the body of an Ascidian, and intercepts the passage to its mouth of some good tidbits, yet we cannot regard it as a parasite.

But should an animal kindly render a service to his neighbor, whether keeping his set of teeth in order,* or in removing the detritus which encumbers certain organs,† we cannot say that it is a parasite. It is no more a parasite than he who squats by the side of a vigilant and clever neighbor and quietly takes his siesta,‡ or he who contents himself with the fragments which fall from the jaws of his acolyte.§ It is no more a parasite than he who, like the Remora, lazily anchors himself to a good swimmer, and fishes by his side without fatigue to his fins. All these animals are no more parasites than the traveller who installs himself in a pleasure carriage, extends his hand in passing, or carries a crust of bread in his pockets. There are also mutual services rendered among several species, services performed by reciprocal kindness, and *mutualism* can even take its place by the side of *commensalism*. Those which deserve the name of parasites are maintained at the expense of their neighbor, whether they reside voluntarily in its organs, or abandon it for a while after each repast, as the leech or flea.

The true parasites are very numerous in nature, and we should wrongly imagine that they live an unhappy and monotonous life. There are among them some alert and vigilant enough to sustain themselves for a part of their life, and only need aid at determinate periods. They are not, as has been believed, exceptional and strange beings without any other organs than those simply for

* A plover enters the mouth of the crocodile and removes the débris that the animal, from its immobile tongue, cannot get rid of. It is a living toothpick. This fact was already known to Aristotle and has been since verified.

† The opalinas of the rectum of frogs.

‡ A screech owl in Mexico places itself under the care of a small subterranean rodent, excessively alert and vigilant, the spermophile. He acts as sentinel at the door of this house, say the people of the country, and the owl lives in perfect quietude.

§ An annelid of the genus Nereis establishes itself by the side of and in the same shell with the hermit crab.

maintaining life. A large number of them are as well provided as others with organs for working, and only seek aid at certain periods in their lives. There is not, as has been thought, a special class of parasites, but all classes of lower animals contain them. We may divide them into different categories; in the first we may reunite all those which are free at the beginning of life, swimming about and taking their sport without seeking aid of any one, until the infirmities of age oblige them to seek refuge. Covered with the *toga pretexta* they live at first like true Bohemians and take their rest in some good inn.* Sometimes it is both the males and females which seek this kind of aid at the coming on of old age;† at other times it is the females alone, while the male continues his vagabond life.‡ It happens also that the female drags along her spouse, and maintains him completely during his captivity; the male remains a small boy in size as well as habits, and if the host who feeds her, serves him with liquor, she in her turn affords her husband food.§ Few females of the Lernæans can be found which do not carry about with them their liliputian males, who do not quit their wives any more than their own shadows. All the parasitic crustacea take their place in this first category.

We also find some — those hobgoblins of ichneumons for example — which are perfectly free in their adult age, but call for support in their youth. There are numbers of these insects, which on leaving the egg are literally put to nurse; but the day when they throw off their larval robes, they know no restraint, and armed from head to foot, they bravely seek adventures like other insects.‖ In this category are found the parasitic dipterous and hymenopterous insects.

There are also some which are classified from their mode of life; all changing their hotel, not to say establishment, according to their age and constitution. From the time they leave the egg they solicit favors, and all their journey is vigorously marked out in advance. We happily know to-day the steps in this journey of the cestode and trematode worms. These flat and soft worms begin life in a sort of vagabondage, provided with a ciliated coat,

* All the Lernæans, the ticks, etc.

† The Bopyridæ among crustacea.

‡ The *Filaria medinensis*, or guinea worm, and several others.

§ The Lernæans in general.

‖ The Ichneumons and Œstrus among insects.

which serves them as a locomotive garment, but scarcely do they essay to use their delicate limbs, than they claim the aid and lodge in their first hotel; restless and unquiet, they soon abandon it for another home, and then reëstablishing themselves are condemned to perpetual seclusion.

That which adds to the interest which these feeble and timid beings inspire, is that at each change of their domicile, they change their costume, and also, arrived at the end of their peregrinations, they wear a virile toga, not to say a wedding dress. It is only under this last envelope that the sexes appear, for up to this time they have thought little of family cares.

Most of the worms which have the form of a leaf or of a ribbon, are subject to these peregrinations accompanied with changes of costume, and those which do not arrive at their final stage, generally die without posterity.

Not the least interesting is the fact that these parasites do not inhabit indifferently such or such organs of their host; all begin modestly by the almost inaccessible mansard roof, and end their lives in the large and spacious apartments of the first floor. At first they care only for themselves, and are contented, under the name of *Scolex* or vesicular worms, with connective tissue, muscles, the heart, the ventricles of the brain, or even the ball of the eye;* later they busy themselves with the cares of their families, and occupy the larger organs, as the alimentary and respiratory tracts, always in free communication with the outer world; they have a horror of being shut up, and their offspring reclaim an existence in the broad world.†

It is not always easy to indicate the identity of those personages which visit one day the saloons, in embroidered dress, the next the most obscure closets in a beggar's costume.

There is a last category in which are found those who claim aid during their whole existence; penetrating at once into the body of their host, they do not move, but lodge there from the cradle to the tomb.

It is only a few years since we did not suppose that a parasite could live in any other animal than that in which we found it. All helminthologists, with few exceptions, regarded the intestinal worms as formed without parents in the same organs they in-

* All the sexual Cestoids.

† Most of those worms called ectoparasites, as the Tristomas, etc.

habited. We had observed, even for a long time, the parasitic worms of a fish in the intestines of certain birds; we had even instituted some experiments to assure ourselves of the possibility of these passages,* but all these experiments had only given a negative result, and the idea that transmigration was necessary was so completely unknown, that Bremser, the first helminthologist of his age, accused Rudolphi of heresy when he stated that the ligules of fishes could live in birds.

At a period nearer ours, our learned friend Von Siebold, called with good reason the prince of helminthology, shared more completely this opinion, in referring the Cysticercus of the mouse to the Tænia of the cat, but regarding this young worm as a stray, sick and dropsical being. To his eyes the worm had made a false journey into the mouse; the Tænia of the cat could only live in the cat. Was Flourens romancing when I announced to the French Institute that it was necessary for these cestoid worms to migrate from one animal to another in order to pass through the phases of their development?

At present in the zoological institute we daily repeat with the same success experiments on these transmigrations, and lately our learned friend R. Leuckart, who directs with so much talent the Institute of Leipzig, has discovered, in company with his student Metznikoff, some transformations of worms accompanied with a change of sex; that is to say, they have seen some Nematoid parasites of the lungs of frogs, either always females or hermaphrodites, produce males and females which bear no resemblance to their mother, and whose habitual abode is not in the lungs of the frog, but in humid earth.† Here we have a female, born a widow, who cannot live without aid, and who brings forth sons and daughters able to take care of themselves. The mother is parasitic and viviparous, the children are, for their whole lives, free and oviparous.

This leads us to that other sexual peculiarity, lately observed, of different males and females in one and the same species, which give birth to young which do not resemble them: the same animal or rather the same species arises from two different eggs, fecun-

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*Abildgaard had seen some ligules (a species of intestinal worm) of fishes, in the intestines of the merganser duck. It is a fact that these worms do not die immediately after their entrance into a strange host.

†*Ascaris nigro-venosa*, and other Nematoides.

dated by different spermatozoids.* Though these transformations are to-day perfectly known and believed, yet naturalists quite often attribute the honor of this discovery to our confréres who have not known that the demonstration had been entirely made and that the new interpretation was generally accepted. But to return to our subject. Aid is thus as varied as we find in our own world: to one is furnished the domicile,† to others the table,‡ and to a certain number a livelihood in lodgings.§ It is a complete system of lodging and subsistence, besides the best arranged philozoic institution. But if on the part of these paupers, we see that they render each other mutual aid, we should not regard them as wholly parasites or commensals. We believe we should be more just in calling them *mutualists*, and mutualism reclaims a place, as we have before said, by the side of commensalism and of parasitism. It will be necessary also to find a qualification for those which, as certain crustacea and even birds, are *spongers* or *sharks*‖ (*des pique-assiette ou des écornifleurs*) rather than parasites; and for others which pay for the aid rendered them by malicious deeds.¶

And how shall we designate those which, like the little plover of which we have already spoken, render a service that we may compare to medical assistance?

The plover indeed acts as a dentist to the crocodile, as a small species of frog acts as an accoucheur to his wife in using his fingers as forceps to bring forth the eggs into the world. And the beef-eater, does it not perform a surgical operation each time that it opens with its beak, the tumor on the back of the buffalo which contains a larva? It is an operator who pays for his keeping. Nearer at home we see the starling render in our fields the same service as the beef-eater in Africa; and can we not say that there is

* Insects, Crustacea and worms furnish examples. An Isopod, *Apseudes anomalus*, has two forms of males; the ordinary, or the more common, resembles the female. The Cumaceæ also have two sorts of males; the more common also resembles rather the female, and is found all the year, while the other is rarer, and only appears at certain epochs of the year. We observe the same phenomena in several other Crustacea, as the *Pontoporeia affinis*, *Cypridina teres*, *Cyprina Lilljeborgii* and the *Philomedes Mariæ*. These observations have been made by Sars. M. Lespès recognized two sorts of males and two sorts of females in *Termes lucifuga*; *Nereis Dumerilii* has likewise two sexual forms, the nereidian and the heteronereidian form. A nematode worm, *Leptodera appendiculata*, is a similar instance. For a long time we have known the existence of winter and summer eggs in the same animal.

† The Alepas and many others. ‡ The leeches.

§ The greater number of true parasites. ‖ Piqui-bœuf et Milan parasite.

¶ The ichneumons end by killing the larva which has given them life, after having eaten them piece by piece.

among these animals more than a specialty in the act of healing? We need not forget that the undertaker is a common personage in nature and that it is never without some profit to himself or his offspring that this sombre workman buries dead bodies.* There are even some animals not without some analogy with the shoeblack or the scourer and which perform with a certain sort of coquetry the toilette of their neighbors.†

And how shall we designate those birds known under the name of *stercoraries* which profit by the meanness of gulls to live in idleness? The gulls surpass in their strength of wing; the stercoraries end by making them disgorge and share with them the profits of the fishery. Pursued too closely these timorous birds disgorge the contents of their crops to lighten themselves, as the smuggler who sees no other means of safety than in abandoning his load. We should not always ascribe these habits to the species as a whole, since in the mosquito it is only one of the sexes which seeks a victim. In general all these animals live from hand to mouth, and if there are some which know how to economize, there are likewise those which do not ignore the advantages of a savings bank.‡ Like the crow and magpie there are some which care for the morrow and save the overplus of the day.

We have spoken: this small world is not always easy to understand, and in these societies each one contributes his capital, some by industry, others by force or strategy, and he is more a man than a Robert Macaire who shares nothing at all and makes the most of everything not his own.§

Each kind of animal may have its parasites and commensals, and each animal may have even different kinds and various categories of them.

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*Among insects the Necrophori are known, as the name indicates, to fill this rôle.
†The Caligi and Argulæ, etc., among Crustacea.
‡ The bees and all insects living in society.
§ The Dromias, Paguri, Cenobites, etc.

ON THE DISTRIBUTION AND PRIMITIVE NUMBER OF SPIRACLES IN INSECTS.*

BY A. S. PACKARD, JR.

WHILE engaged in dissecting certain Sphinx and Bombycid larvæ, my attention was called to an interesting feature in the distribution of the thoracic portion of the main tracheæ and their stigmatal branches. In the larva of Sphinx and of *Platysamia cecropia*, and in fact so far as I am aware in all lepidopterous larvæ, there are nine pairs of spiracles, or stigmata, of which eight are abdominal, there being a pair to each first eight segments of the abdomen; while there is but one pair of thoracic spiracles, which are invariably, so far as I am aware, situated on the prothoracic segment. On laying open the body of a Sphinx larva a large number of branches are seen to arise from the prothoracic and basal, or first pair of abdominal spiracles. Now between these two points it will be remembered that there are no spiracles or any external signs of them. And yet the main trachea between these two spiracles deviates from its course and bends down to send off a small trachea to the place where, did a spiracle exist, we should look for it, *i.e.*, to a point in the suture between the mesothoracic and metathoracic segments, where in hymenopterous larva a spiracle does exist. From the upper side of the main trachea two larger branches are sent towards the interior of the body. These apparently correspond with the numerous branches sent off from the spiracles.

In *Platysamia cecropia* the same disposition of the main trachea may be seen, as it bends out in the same way towards the usual site of the spiracle in other groups of insects, and throws off three branches, one outward towards the tegument, small, and apparently rudimentary, while the two others, directed inwards, are larger than in Sphinx.

This has led me to ascertain how the spiracles are distributed in other groups of insects, and what is their usual number. While in the lepidopterous larvæ there is but one pair of stigmata, which are situated on the prothoracic, or first thoracic, seg-

*Read before the National Academy of Sciences, New York, November, 1873.

ment, in the larvæ of the higher Hymenoptera, *i.e.*, the bees and wasps (I have examined Bombus, Xylocopa, Halictus, Andrena, Vespa and Polistes), there are no spiracles on the prothorax, but a pair on each of the two following thoracic segments. In all these the thoracic spiracles are as well developed as those on the abdomen, and in Bombus larvæ the tracheæ proceeding from the spiracles are as well developed, being large and elongate barrel-shaped just after leaving the stigmata, and beyond subdividing into several branches. In two genera of Tenthredinidæ, and probably in the family generally, the spiracles are arranged as in the lepidopterous larvæ, there being but one pair, the prothoracic. In the Uroceridæ, however, Tremex in its larval state has two pairs, one prothoracic and one metathoracic, the anterior pair twice as large as the posterior pair. So it would seem that while no known hymenopterous larva has more than two pairs of spiracles on the thorax, yet three pairs may be found on different rings in different groups, though not actually existing in one individual. The ideal number of pairs is three, or for the entire body eleven. In the Diptera the Cecidomyiæ have nine pairs of stigmata, of which one is thoracic (on the prothorax), while the eight other pairs are abdominal. In the Muscidæ, there are two pairs only, one prothoracic, the other anal, or situated on the ninth segment of the abdomen. So that in this group we have ten segments which bear spiracles, though no single species is known to have more than nine pairs of spiracles.

In the Coleoptera there are usually nine pairs of spiracles, one thoracic, and eight abdominal. The thoracic spiracles are either on the pro- or meso-thoracic segment.* In the adult Melolontha and other beetles Strauss shows that a spiracle exists between the meso- and meta-thorax, which is not present in the larva. If this be so, then the ideal number of pairs in Coleoptera is ten.

In the Hemiptera and Orthoptera† there are two pairs of thoracic spiracles present on the two anterior segments; and

*It is often difficult to say on which segment of the coleopterous larvæ the thoracic spiracles are placed, they are so near the suture separating the pro- and meso-thoracic segment, and authors differ considerably about them. In the larvæ of Carpopilus, Cetonia (by some they are stated to be on the meso-thoracic ring), Anobium, Tomicus and Xanthochroæ the spiracles are said to be placed on the prothoracic ring (Candez). In Magdalinus they are situated on the suture between the segments, and in the Longicorns they are in some genera placed on the posterior edge of the prothoracic, and in others on the anterior edge of the meso-thoracic ring.

†Gryllidæ and Acrydii (Dufour).

in the Neuroptera* there are the same number, but none on the prothorax.

In the larva of *Corydalus cornutus* there is a pair of spiracles on the prothorax, but they are no larger than those on the basal segment of the abdomen. It is difficult to say whether they are situated on the prothoracic or mesothoracic segment, but I am inclined to regard them as placed on the extreme hind edge of the prothoracic ring.

A curious fact may be here mentioned, as I have not seen it noticed before, regarding the distribution of the tracheæ in the larva of Corydalus. The main tracheæ suddenly enlarge from the second abdominal spiracle to the base of the head, when it subdivides and distributes branches to the head. From the spiracle on the basal abdominal segment a trachea, as large as the anterior swollen portion of the main trachea, takes its origin and passes directly under the main trachea. Now both tracheæ send a branch opposite to where the mesothoracic stigma should be, if present, *i.e.*, on the hind edge of the ring. Both branches of the tracheæ, the main one and its fellow, anastomose perfectly over the branch sent off to the prothoracic spiracle.

This doubling of the tracheæ, which are so very large, forms evidently an hydrostatic, as well as respiratory, organ and serves to lighten the anterior and heavier portion of the body, as in the dilated air sacs of the terrestrial insects. This fact seems to sustain the view of Gegenbaur,† that the tracheæ were at first closed, forming air-bladders, and afterwards performed the function of respiration.

It would appear from these facts that while no more than ten pairs of spiracles are to be found on the bodies of any one species of the groups of insects above mentioned, yet that eleven segments of the body, in different species taken collectively, bear them. Now if we turn to the Thysanurous genus Campodea, we shall find on the authority of Meinert that it bears spiracles on each thoracic segment. From this fact we are inclined to regard eleven as the normal primitive number of pairs of spiracles. Probably the larvæ of the different groups of winged insects had originally a pair on each thoracic segment. Certainly at least on evolutional grounds from the indications in existing caterpillars

*There are two pairs of spiracles in the meso-thoracic and meta-thoracic rings respectively in the Libellulidæ and Ephemeridæ (none abdominal, as the larvæ have none), and in the Myrmeleons and Perlidæ.

†C. Gegenbaur, Gründzüge der Vergleichenden Anatomie, 2te Auflage, 1870. p. 437

we are perhaps warranted in concluding that the ancestral type of lepidopterous larvæ was provided with two pairs of thoracic spiracles.

GEOGRAPHICAL VARIATION IN NORTH AMERICAN BIRDS.*

BY J. A. ALLEN.

Probably the birds of no equal area of the earth's surface are better known than those of North America north of Mexico, or of the whole continent southward even to the Isthmus of Panama. No museums in the world, probably, possess so large suites of specimens of single species as there are of North American birds in the Museum of the Smithsonian Institution and in the Museum of Comparative Zoology, nor from so many localities. In many instances single species are represented by hundreds of specimens collected at frequent intervals throughout their known range. Those contained in the Smithsonian Institution have been most carefully elaborated by Prof. Baird and others, whose reports upon them have justly acquired a world-wide reputation for their thoroughness and accuracy. Those in the Museum of Comparative Zoology have also been carefully studied.

Briefly, then, what are the facts and the general results that have followed the investigation of this exceptionally large amount of material? What are the allowable inferences, and what general principles have been apparently established? To answer these questions as briefly as may be is the object of the present remarks, — premising, however, that the formerly current opinions respecting the rank of a certain class of forms heretofore generally regarded as specific have been radically modified. Intergradation has been frequently traced between widely different forms, a gradual coalescence in scores of instances having been positively established, and rendered extremely probable in a large number of others.

In North America geographical variation exhibits two marked phases : — (1) a differentiation with differences of latitude and elevation, and (2) differentiation with differences of longitude; which, for convenience, may be termed respectively latitudinal

*From the Proc. Bost. Soc. Nat. Hist., vol. xv, p. 212.

and longitudinal variation.* In respect to both, differentiation occurs in different degrees in different groups, in accordance with their general tendency to variation, or, as it were, in proportion to their normal degree of plasticity. In regard to variation with latitude the modifications are apparently more general than in what I have termed longitudinal variation. In latitudinal variation the differentiation affects not merely color, but size and the details of structural parts, whereas color appears to be the main element affected by longitudinal variation. The fact of variation in size has been conceded as a general law by the majority of at least American ornithologists and mammalogists since it was so fully established by Prof. S. F. Baird in 1857 and 1858, in his admirable reports on the mammals and birds of North America, published in the series of Government Reports on the explorations and surveys of the various Pacific Railroad routes. Prof. Baird then and subsequently † called attention to the fact of the greater length of the tail in several species of birds at certain localities, and cites instances of the larger size of the bill at southern points, and the paler color of the plumage of the birds of the Plains and the arid peninsula of Lower California. All his subsequent works have furnished numerous citations of similar variation with locality, but instead of insisting upon any common tie connecting these phenomena as the result of general laws, they were viewed as evidences of specific differentiation. The differences are, indeed, so great between many of the forms now known to intergrade that it is not surprising that they were regarded as different species when known from only a few examples, apparently unconnected by intermediate forms. Subsequently, however, it has been found that they are not trenchantly separated, intermediate forms so linking them together that they can be only vaguely diagnosed. These connecting links, inhabiting — at least in the breeding season — localities intermediate in geographical position and in climatic conditions to those frequented by the more extreme forms, suggest an intimate genetic relationship and a differentiation mainly or wholly through climatic influence, or the diverse conditions of environment.

Latitudinal variation presents the following phenomena, which are of such general occurrence that even the exceptions, if such there really be, are exceedingly few.

* See Bull. Mus. Comp. Zool., vol. ii, pp. 220–247, *et seq.*, April, 1871.
† Amer. Journ. Sci. and Arts, vol. xli, 1866.

1. *As regards Size.* There is a general reduction in the size of the individual from the north southward, amounting not unfrequently to as high as ten to fifteen per cent. of the maximum size of the species. The reduction is much greater in some species, and in some groups of species, than in others, but is almost invariably considerable and easily recognizable.

2. *In respect to the Bill.* The variation of the bill is somewhat inverse to that of the general size, as a rule the southern forms having generally relatively, and often absolutely, larger bills than northern ones, the increased size taking different proportions in different species and different styles of bill. Those of a stout, thick, conical form generally increase in general size, but especially in thickness. Those of a slender, attenuate form become slenderer and relatively longer at the southward, with a decidedly greater tendency to curvature.

3. *In respect to the Claws.* A similar increase in size is apparent in the claws, especially in that of the hallux, at southern localities, perhaps less marked and less general than the increase of the bill, with which it evidently correlates.

4. *In respect to the Tail.* A marked elongation of the tail at the southward has been noticed in many cases, both in Cape St. Lucas birds (*Baird*) and in those of Florida.

5. *In respect to Color.* The differences in color are especially obvious, and may be reduced to two phases of modification: — (*a*) a general increase in intensity at the southward, and (*b*) an increase in the extent of dusky or black markings at the expense of the intervening lighter or white ones; or, conversely, the reduction in size of white spots and bars. Under the general increase in intensity the iridescence of lustrous species becomes greater, and fuscous, plumbeous, rufous, yellow and olivaceous tints are heightened in species with the color continuous in masses. Under the repression of light colors the white or yellowish edgings and spots on the wings and tail become more or less reduced, and frequently to a great degree, in species barred transversely with light and dark colors; the dark bars widen at the southward at the expense of the white or lighter ones, sometimes to such an extent as greatly to change the general aspect of the species, as is the case in the *Ortyx virginianus* of the Atlantic States, and in other well known species. Also under the tendency to the increase of dark colors, longitudinal streaks and blotches on a light ground increase in extent and intensity of color.

In respect to longitudinal variation, the differences appear to be mainly those of color, and to hold a direct relationship to the humidity of the climate. On the arid plains of the middle and western portions of the continent the annual rainfall is less than half that of the eastern half of the continent, while a rainy belt occurs on the Pacific coast, stretching northward from near the mouth of the Columbia River to Alaska, over which the annual rainfall is double that of any portion of the eastern half of the continent. Taking the species that present a nearly continental range, we find that almost invariably they pass gradually into the pallid forms of the interior at the eastern edge of the arid plains, the greatest pallor being developed in the driest regions, as the peninsula of Lower California and the almost rainless belt along the Colorado River, and northward along the eastern base of the Sierra Nevada Mountains; that on the Pacific slope they again reassume nearly the tints of the eastern form, but more to the northward, over the above-mentioned rainy region, they acquire a depth of color far in excess of what the species presents in the Atlantic region. This coincidence of bright and pale tints, with the relative humidity of the locality is certainly suggestive, if not demonstrative, of the relation of cause and effect between these two phenomena, since the same rule is traceable, over large portions, at least, of the Old World; the Scandinavian forms, for instance, being darker colored than the conspecific races of Central Europe, and these again darker than those of Northern Africa and the adjacent regions. Humidity alone, or in conjunction with greater intensity of light, seems equally well to account for the increase of color to the southward. Yet, from the well known bleaching effect of sunlight, intensified by reflection, upon the colors of animals living upon sandy islands, and seabeaches, and desert interior regions, it seems doubtful whether the larger share of modification in intensity of color in birds may not be due to humidity alone, or to humidity and a high temperature together, rather than to intensity of light.*

In regard to the enlargement of peripheral parts at the southward, it seems not unreasonable to suppose that the increase of temperature in stimulating the circulation in these exposed members may have something to do with it, especially in view of the

* See on this point further remarks by the same writer in Proc. Bost. Soc. Nat. Hist. vol. xvi, June, 1874.

evidence afforded by mammals, which in general present climatic modifications parallel with those of birds.

Whatever may be the cause of the above modifications of structure and color at different localities, we certainly find the following coincidences: I. In accordance with the increase in the intensity of color in individuals of the same species from the north southward, in the northern hemisphere, the brighter colored species in genera represented in both the temperate and tropical regions occur, as a general rule, at the southward; the same fact holding good also for sub-families. In cosmopolitan genera, families, etc., the tropical species are almost always brighter colored than the extra-tropical ones. All the most gorgeously colored families of birds are either exclusively tropical or semi-tropical, with generally the outlying species more plainly colored than the average for the family. II. In accordance with the increase in the size of the bill at the southward, all the species that have this member enormously developed are tropical or semi-tropical, not only such families as have the beak at its maximum of development, as the toucans and hornbills, but in all groups in which it is unusually large, the extreme development is reached in the intertropical regions. III. In respect to the tail, with very few exceptions, all long-tailed forms attain the highest development of this member within or near the equatorial regions.

The facts indicated above, in respect to the inosculation of forms formerly regarded as specifically differentiated, will evidently require modifications of the hitherto accepted nomenclature. Evidently many of these forms are so strongly marked that they should be in some manner recognized in nomenclature, though admittedly of less than specific rank. Most naturalists now practically recognize as species such groups of individuals as are not known to graduate by nearly imperceptible stages into any other similar group; and as varieties, such groups of individuals as occur at certain localities, or over certain areas, which differ more or less from other groups inhabiting other (generally contiguous) localities, with which there is evidence that they do, more or less fully, intergrade. Convenience seems to demand such a course, in order to enable the naturalist to specify what particular variety or race of a species inhabits a given section of country — a method, in fact, already more or less generally practised.

Finally, what is the bearing of these facts of geographical va-

riation upon the question of origin of genera and species? Having approached the subject from a geographical standpoint, my own impression of the importance of the conditions of environment in modifying the characteristics of animals may have unduly impressed me; yet that they exercise a greater influence than is currently recognized I think must be admitted. How, for instance, can natural or sexual selection satisfactorily account for the occurrence of pallid forms in arid, semi-desert regions, and of brighter colored forms in contiguous humid districts, or the generally increased intensity of color southward, and its maximum development only toward and within the tropical regions? In many cases, it is true, the change in color may be protective, as it doubtless is in the assimilation of the pale tints of birds and other animals inhabiting arid plains to the generally gray color of the vegetation and the earth itself in such localities; yet, as the resemblance of the birds of these arid districts when young or in fresh plumage to those of the adjoining regions at the same season is much greater, as a general rule, than at the end of the breeding season, we have thus palpable evidence of the direct modification of color by environing conditions. Again, it is hard to see how the intenser and darker shades of the iridescence of the *Quiscali* in the South Atlantic and Gulf States, or their slenderer and more decurved bill, or the greater breadth of the transverse black bars on the breast of the southern form of *Ortyx Virginianus* can be in the one case any more "protective," or in the other give greater facility in obtaining food, than the different colors and the differently proportioned beaks of the northern forms of these species; or of what advantage the large claws and long tails can be at southern localities rather than at northern. The variation in color is not apparently any better explained by sexual selection than are the other modifications by natural selection, for it is hardly supposable that sexual selection should act in so uniformly an accelerated degree toward the southward, or so generally from arid regions toward moister ones. On the contrary, it is just this gradual and general modification over wide areas that apparently points to climatic influence as the differentiating cause. There is, further, frequently a closer assimilation of the sexes at the southward, as among the *Icteridæ*, through the greater increased brilliancy of the female as compared with the male, which is rather

the reverse than otherwise of what is commonly supposed to be the result of sexual selection.

Freely admitting, however, that both natural selection and sexual selection are causes of modification in the gradual differentiation of animals, I am led to regard them as secondary rather than primary elements, and that climate and other environing conditions take a larger share in the work than the majority of evolutionists seem willing to admit. Evidently no single law will explain all the phases of modification by descent, and in addition to those above alluded to, doubtless what Hyatt and Cope, among American zoologists, have termed the laws of acceleration and retardation are among the other causes of the modification. In birds, even, phenomena are apparent that cannot be strictly admitted into the category of geographical or climatic variations, but seem singularly to combine some evident features of this character with a retention of a few embryonic characteristics, especially in respect to coloration, of allied intergrading forms, as occurs in some of the birds of the middle portion of the North American continent as compared with those of the eastern portion. Again, in respect to insular regions, while the above mentioned general laws of climatic variation are there evident, certain other exceptional modifications obtain, that seem specially to characterize those regions.

A word, in conclusion, respecting hybridity: — When comparatively few instances were known, in which specimens combined in various degrees the characters of two quite distinct forms, their synthetic character was generally explained by the theory of hybridity; but the irrefragability of the evidence now at hand in proof of the intergradation of such forms over large areas, — the transition being so gradual as to occupy hundreds of miles in the passage, — and also coincident with a similarly gradual change in the conditions of environment, together with the demonstrable evidence of the power of climatic influence, seems to furnish a far more satisfactory explanation of these perplexing phenomena. But an advocate of the theory of hybridity might still assume that this gradual transition over a wide area is no objection to the theory, since the gradual fading out of the impression of contact in either direction from the line of junction of the respective habitats of two forms is just the result that would be anticipated

from such a sexual intermingling of the forms in question. But the real objection to the theory — granting the possibility of hybridization on such a gigantic scale, which seems really improbable — is, that widely different forms occur also at different points in latitude, between which each successive stage of gradual differentiation can be readily traced, where hybridity can scarcely be supposed to account for the gradual change. Furthermore, gradual differentiation is now known in so many cases that it amounts to the demonstration of climatic variation as a general law, by means of which a species may be safely predicted to take on a given character under certain specific climatic conditions. If the theory of hybridity be urged to account for the intergradation of forms occurring at localities differently situated in respect to latitude, as has sometimes been done, it evidently falls under the weight it has to support; and yet there seems to be little better evidence in its behalf in cases where the intergrading forms happen to be differently situated in respect to longitude.

To describe in detail, or even to give illustrations, of geographical modification would require more space than would be proper to use in this connection, especially since a preliminary exposition of the facts upon which the preceding generalizations have been based, has already been presented in two papers in the Bulletin of the Museum of Comparative Zoology (Vol. ii, No. 3, April, 1871, and Vol. iii, No. 6, June, 1872).

REVIEWS AND BOOK NOTICES.

Recent publications on Ornithology. — Like the pages of the Naturalist with which our readers are of course sufficiently familiar, recent issues of nearly all our scientific institutions show notable activity in ornithology, and a number of papers have accumulated on our table. In the Philadelphia Academy's Proceedings, Mr. Thos. G. Gentry has described peculiarities in the nidifications of *Sayornis fuscus* (1873, p. 292) and *Vireo solitarius* (*op. cit.*, 354); Mr. B. R. Hoopes has published a new variety, *Krideri*, of *Buteo borealis* (*op. cit.*, 238, pl. 5) from Iowa, a pale race of the dry interior, apparently as distinct as some others now currently recognized. In the Boston Society's Proceedings (xvi,

1873, 106), Dr. Brewer has continued the development of Lt. Bendire's Arizona oölogical collections, which was begun in the NATURALIST (June, 1873, 321) describing several varieties or novelties. The identifications appear to be correct, excepting that of *Carpodacus Cassinii* which should, we believe, stand as *C. frontalis*, and that of "*Myiadestes Townsendii*," an evident slip of the pen for *Phœnopepla nitens*.

Dr. Brewer has also a brief notice of the North American *Hylocichlæ* (Pr. B. S. N. H. xvi, pt. ii), in which he takes the ground that there are eight species of this subgenus, a view at variance with that now commonly accepted by ornithologists, who reduce the number to four or five. For ourselves, we concur more nearly with the mode in which the several forms are handled in the late work of Messrs. Baird, Brewer and Ridgway.

The important business of cataloguing the Boston Society's collection of birds, ably begun by Mr. A. Hyatt, has been carried on by Mr. R. Ridgway, who has gone carefully over the series of *Raptores*, identifying the specimens and naming them upon his protracted and favorably known studies of this group. His paper (Pr. Bost. Soc. xvi, 1873, 43), though simply a catalogue, becomes at once an authority, and places the collection upon a more satisfactory basis than it has hitherto rested upon. We wish that arrangements could be made for him to go over the Philadelphia Academy's *Raptores* in like manner; it is a very desirable piece of work, which must be done some day, and we know of no one more competent to do it. The article is supplemented with monographs of the genera Micrastur, Geranospiza, Rupornis and Glaucidium, worked out with the same patient care and to the same extent of analytical detail which have marked his previous labors. Without here entering upon a criticism of certain determinations, as some of those in the genus Micrastur, which will require remodelling, we may witness the extent and importance of his investigations in these groups.

The same author has lately cleared his desk of several additional papers, giving as the benefit of much study, the results of which are only now become apparent. The most notable of these (Essex Inst. Bull. v, 197) describes a number of new forms of North American Birds, from his own and Prof. Baird's manuscripts. The descriptions are virtually of one parcel with those lately published in the NATURALIST, in advance of the great work

of Messrs. Baird, Brewer and Ridgway, partly in courteous accommodation of ourselves, in order that the names might become available for our "Check List," then in press. Some twenty-five new names are proposed all together, mostly varietal.

Mr. Ridgway's fourth and fifth papers are local lists of the Birds of, respectively, Colorado and the Salt Lake Valley. The first of these is a digest of the previous literature upon the subject, together with the large amount of material gathered by, more particularly, Mr. C. E. Aiken; it comprehends the birds of the whole territory. The last named may be regarded as in some measures complementary to Mr. J. A. Allen's recent 'Reconnoissance' (Bull. Mus. Comp. Zool., iii, 1872), Mr Ridgway's investigations having been conducted from May until August, while Mr. Allen's were autumnal. The two together go very far towards completing our knowledge of the presence and movements of the species within the region mentioned.

In evidence of the great activity of research at present in the southwest, may be instanced an additional local list by Mr. H. W. Henshaw, giving a résumé of the ornithological results of his season's connection with the Wheeler Explorations west of the 100th meridian. The ground covered is partly what we went over in 1864–65, which has been latterly reworked by Lt. Bendire, U.S.A. The list is confined to Mr. Henshaw's own observations, and may be regarded as perfectly reliable, not only in the identifications of the species, now contained in his beautiful collection, but in the observations upon their movements and relative frequency.

Returning to Mr. Ridgway's contributions to ornithology, we have next to note an important paper (Ann. Lyc. N. Y. x, 1874, 364) upon the birds of Illinois, with one exception the first article bearing upon the whole subject. Mr. R. H. Holder's paper (Trans. Ill. Agric. Soc. iv, 1859–60, 605; 247 species, minus two not valid) was a simple enumeration, and, though excellent as far as it went, lacked the essential qualifications of discriminating the several categories of residents, migrants and stragglers. Kennicott's contributions (*op. cit.*, i, 580; 187 species) were confined to Cook county, and to a supplement of 22 species to Henry Pratten's list of the Birds of Wayne and Edwards counties (184 sp.+22=206; *op. cit.*, 596) with the addition of *Plotus anhinga* and *Tantalus loculator* (Pr. Bost. Soc. v, 1856, 391). With the exception of a paper which we have not seen, by F.

Brendel (Giebel's Zeitsch. 1857, 420), and Mr. Allen's Notes on the Birds of Northern Illinois (Mem. Bost. Soc. i, 1868, 502; 94 species), no other formal papers on the subject have appeared to our knowledge, though Mr. Ridgway himself has twice communicated short pages to the NATURALIST (vi, 1872, 430; 4 rare species; and Apr., 1873). The present list, occupying thirty pages, gives 311 species certainly occurring, with 43 "probabilities," representing a total of nearly 350 species, constituting the probable avifauna of the state. Of these 176 are known to breed. The two families, Sylvicolidæ and Fringillidæ, head the list with no fewer than 36 species apiece. The Anatidæ follow with 34, the Scolopacidæ with 25, and the Falconidæ with 20. Sixteen families have but a single Illinois representative; the remainder average about five species to a family. All the North American families excepting Chamæidæ, Procellariidæ and Alcidæ occur in the State. Among the breeders, the Sylvicolidæ and Fringillidæ are as before best represented with respectively 21 and 16 species. Lake Michigan furnishes a large quota of the stragglers, among waders and swimmers. Several species occur not hitherto attributed to the State, and the number of rarities is quite large. Being based upon personal observations, as well as upon a command of the published literature of the subject, and possessing the best qualities of a local list, the present paper at once becomes the authority, superseding the previous incomplete records. We notice considerable nomenclature to which we are unaccustomed, but this matter scarcely requires criticism in a paper having no special classificatory object; though we must demur at what seems to us, in some instances, a forced reduction to varieties of accredited species upon some theory, perhaps, of varietal relations with European forms whose intergradation with ours remains to be proven. It is unsafe to presume in such cases, or even to argue from analogy; nor can we say, at present, that a certain amount of observed difference shall be held specific, and another amount only varietal; we want to see the links.

We have an ornithological paper from a comparatively new quarter, by a writer of whom we have not before learned in such connection. In preparing a Report on the Birds of Minnesota (Bull. Minn. Acad. Nat. Sc. i, 1874, 50) Dr. P. L. Hatch does not appear to have availed himself of Mr. T. M. Trippe's late Communication (Bull. Essex Inst. vi, 1871, 113), nor of Dr. J. F.

Head's earlier article (Smith. Rep. 1854, 291). The list includes 230 species, being thus more nearly complete than either of its predecessors, one of which gave 60, the other 138. This number is so near the presumed maximum, that on casually looking up the subject from our own notes we find only about 20 species to be added. Still fewer species should be erased, though there are several we regard as uncertainties, like *Contopus Richardsoni* and *Empidonax pusillus*, while others, as *Archibuteo Sanctijohannis* (given in addition to *lagopus*) and *Nyctale albifrons*, are purely nominal. As usual with scientific printing in a new place, typographical errors are too frequent. It is the most satisfactory enumeration of the birds of this state we have had, while its value as a mere catalogue is much increased by the running commentaries, giving items on the period of occurrence, breeding, relative numbers, etc., of the species, as well as, in many instances, brief notes of habits.

We have not yet reached the number of the faunal lists before us. A long expected paper of great consequence has just appeared in the Memoirs of the Boston Society (ii, 1874, pt. iii, No. II, pp. 265–319); we refer to Mr. G. N. Lawrence's "Birds of Western and Northwestern Mexico." This is based upon the manuscripts and collections of the late Col. A. J. Grayson, of Mr. J. Xantus and Mr. F. Bischoff, placed by the Smithsonian Institution in Mr. Lawrence's hands for elaboration. The collections together represent 316 species, of which not a few were novelties, recently described by Mr. Lawrence, in the Annals of the New York Lyceum and the Proceedings of the Boston Society. The largest and most valuable were made by Col. Grayson, chiefly in the vicinity of Mazatlan. The paper is enriched with copious field notes, Col. Grayson having intended to prepare a full history of the Birds of Western Mexico, with many colored plates of life size — an enterprise most unfortunately cut short by his lamented death. Mr. Lawrence observes that "as a field naturalist he should take rank with Audubon;" and presents extracts of his writings, "exceedingly graphic and of great value, as they elucidate the economy of many species, of which, comparatively, but little was heretofore known." We trust it may not be long before Mr. Lawrence will further elucidate the ornithology of Mexico, with the results of his examination of Sumichrast's Tehuantepec collections, upon which he has been engaged.

Messrs. Jordan and Van Vlieck publish at Appleton, Wisc., in small 4to, a Popular Key to the Birds, Reptiles and Fishes of the Northern States. When the emended edition of this praiseworthy endeavor to unlock this portion of our fauna to students is issued — we understand a revision is contemplated — we trust we may be authorized by the merits of the publication to speak of it more highly than we can at present.

Though somewhat foreign to our present purpose, reference in this connection to Prof. Reinhardt's continued studies on the osteology of Water-birds (Aft. Vid. Medd. Nat. For. Kjöb., 1873, 123) may not be wholly out of place, as we are convinced of the particularly important bearing such investigations have upon the classification of the future. In the late paper referred to, the wing-structure of Procellariidæ is treated with reference to the presence of the one or two supplementary ossicles of the elbow-joint, developed in connection with the "apophyse crochue" of the humerus, and the origin of the *extensor metacarpilongus* and *extensor plicæ alaris* (*tensor patigii* of some authors). He finds the bones in six genera and not in eight; but as the six are the richer in species, it is present in about two-thirds the species of the family. They are peculiar to the family, though other *Longipennes*, as well as Alcidæ and Limicolæ have the humeral hook. He points out their function, and proposes to divide the group primarily upon them. — ELLIOTT COUES.

HISTORY OF NORTH AMERICAN BIRDS.*—The announcement of a work on the ornithology of North America, by the above-named gentlemen, is in itself a guarantee of its interest and scientific value; and the three volumes now published fully satisfy such expectations.

A work of this character, always welcome, is particularly opportune at this time, as the need of a comprehensive "History of North American Birds" has long been felt. For nearly a third of a century from the publication of Audubon's "Birds of America," in 1844, until the present year, no such book has appeared.† As long ago as 1858, the numerous Government expeditions had ac-

* A History of North American Birds, by S. F. Baird, T. M. Brewer and R. Ridgway. Land Birds. 3 vols., large 8vo. Boston, Little and Brown.

† We exclude numerous monographs and more or less local lists; and also certain works, which, while valuable in themselves, contain little or nothing in regard to general and breeding habits.

cumulated so great a mass of material as to necessitate its publication, forming the well-known ninth volume of Pacific Railroad Reports. This was almost entirely technical, and limited to classification and description. Since this date many new species have been discovered and much additional information acquired, which find expression here, together with a résumé of everything of value previously published. The typography is all that could be desired, and misprints are noticeably few in number. The illustrations are excellent, and comprise a full length figure and outlines of the bill, wing, and foot of at least one species of each genus; and sixty-four plates representing the head, for the most part of life size, of each species. Volume I begins with an introduction giving the general anatomical characteristics of Aves, and their classification. Under the first family, or Turdidæ, are included sixteen species and seven varieties. Two only (*T. Pallasi*, with var. *nanus* and var. *Auduboni*, and *T. Swainsoni* with var. *ustulatus*) are found from ocean to ocean, being modified in certain regions as above. *Turdus confinis* is united to *migratorius* as a variety; and *T. iliacus* of Europe is admitted into our fauna, having been twice obtained in Greenland.

Harporhynchus Lecontei and *longirostris* are given as varieties respectively of *H. redivivus* and *rufus*. *Phyllopneuste Kennicotti* Baird is a synonyme of *P. borealis* Blasius, the latter name having priority; it is a Northeastern Asian species, accidental in Alaska and perhaps in Europe (Heligoland). *Saxicola œnanthe* is now recognized as by no means rare in the northern parts of our continent, where it seems to become more abundant yearly. *Regulus Cuvieri* Aud. is included; a second specimen, together with the nests and eggs of the two common species, are still desiderata. The Parinæ comprise twelve species and three varieties, of which the latter two (*P. septentrionalis* and *occidentalis*) are races of *atricapillus*. Sitta includes three species only, *S. aculeata* being given as a variety of *Carolinensis*, and *pygmæa* (III, 502) as "probably a geographical form of *S. pusilla*." Our Creepers are regarded as *Certhia familiaris* var. *Americana* and var. *Mexicana*. Here, as in many other parts of the present work, the tendency to unite as races the closely allied forms of Europe and North America is shown, and, in our estimation at least, most judiciously. In regard to the present species we can say from careful personal observations, that the habits and notes (including

the "very distinct and varied song") are almost precisely identical both in this country and in Europe.

Thryothorus Berlandieri is united to *Ludovicianus* as a variety; and *Troglodytes Parkmanni* with *aedon*. *T. Americanus* Aud. is stated to be *aedon* "in dark, accidentally soiled plumage." *T. hyemalis* and *Alascensis* are given as geographical races of the European *T. parvulus*. *Motacilla alba* of Europe, like *Turdus iliacus*, has been twice obtained in Greenland, and more frequently in Iceland, and is therefore described. A third common European species, *Anthus pratensis*, has also been procured in Greenland, and more recently in Alaska.

Pages 177–325 are devoted to the Sylvicolidæ, and form a very interesting section. Fifty-two species and three varieties are enumerated, the genus Dendroica claiming twenty-three species. *Geothlypis Macgillivrayi* receives a distinct article on pp. 303–305; but on p. 297, and also in the appendix (III, 507), it is stated to be a geographical race of *G. Philadelphia*.

Icteria longicauda is given as a western form of *virens*. Thirteen species of Vireo, with three varieties *V. gilvus* var. *Swainsoni; V. solitarius* var. *Cassini* and *plumbeus*) are described. On pp. 363 and 364, *V. olivaceus* is stated to have occurred in England; but it is somewhat questionable whether the specimen obtained was not *V. altiloquus*.*

The number of North American shrikes has been reduced to two, *Collurio borealis* and *C. Ludovicianus*, with var. *robustus* (=*elegans*, Baird nec Swainson) and var. *excubitoroides*. On pp. 426–428 is given a synopsis of the Certhiolæ, several of which (besides *C. Bahamensis*) may very possibly occur as stragglers in the southern extremity of Florida.

Pyranga Cooperi Ridgway, is united to *P. æstiva*, and our pine grosbeak to *Pinicola enucleator* of Europe. *Pyrrhula Cassini* Baird is "a well marked and distinct species," and not a variety of the European *P. coccinea;* it is a Siberian species accidental in Alaska, and has been once obtained in Belgium. *Loxia Americana* and *Mexicana* are united to *curvirostra* as varieties, and (I, 483) *L. leucoptera* to *bifasciata;* but in the appendix (III, 509) the latter are separated as "entirely distinct" species. The determination of our species of Ægiothus is as follows:—I. *A. canescens* of Greenland, with var. *exilipes* of continental Arctic America; II.

* See a paper by Bree, in the London "Field," May 14, 1870, p. 417.

A. linarius of continental N. A., with var. *Holbölli* of Greenland in summer and continental N. A. in winter; III. *A. flavirostris* var. *Brewsteri*. *Leucosticte griseinucha* is united to *tephrocotis* as a variety, as are three others, *campestris* Baird, *littoralis* Baird, and (III, 509) *australis* Allen. The validity of *Passerculus princeps* Maynard, as distinguished from *Centronyx Bairdi*, is confirmed. *Passerculus alaudinus*, *Sandwichensis*, and *anthinus* are considered to be geographical forms of *P. savanna;* and *P. guttatus* is united to *rostratus*. In the Appendix (III, 513), speaking of the fact that *Coturniculus Lecontei* is intermediate between *C. Henslowi* and *Ammodromus caudacutus*, Prof. Baird remarks that "this renders it necessary to unite Ammodromus and Coturniculus into one genus, recognizing them as subgenera, definable chiefly by the different style of coloration of the superior surface in the two groups," the name Ammodromus having priority.

In the same appendix, p. 516, the capture in California of a specimen intermediate between *Passerella iliaca* and *Townsendi* is said to render it "extremely probable that all the known forms of this genus are but geographical races of one species."

To *Melospiza melodia* are allotted six varieties. *Alauda arvensis* of Europe claims admission, it having been captured in Greenland and Bermuda; and it has also been introduced in the vicinity of New York City, apparently with success. *Eremophila cornuta* "appears to be absolutely identical" with *E. alpestris* of Europe, which latter name has priority. *Sturnella neglecta* is united to *S. magna* as a western race.

Sturnus vulgaris, having been once obtained in Greenland, is included. The raven of North America is considered to be a race of the European *C. corax*. Another judicious change is the referring of *Pica Hudsonica* and *Nuttalli* to *P. caudata* as varieties; *Nuttalli* being regarded as a local aberrant form of *Hudsonica*, differing chiefly in its yellow bill. The difficult family of Tyrannidæ receives a careful and interesting review. *Contopus Richardsoni* is given as *virens*, var.; and *Empidonax Trailli* as *pusillus*, var. *Chordeiles Henryi* is considered to be a western form of *C. popetue*.

Of humming birds ten species are described, including the doubtful *Thaumatias Linnæi*. *Lampornis mango* is mentioned in a foot note only.

The number of valid species of woodpeckers has been considerably reduced, only twenty-three being enumerated, including *Colaptes hybridus*, and omitting *Campephilus imperialis* as extralimital. *Picus Canadensis*, *Harrisi* and *Auduboni* are united to *villosus* as varieties; *Gairdneri* with *pubescens; Picoides Americanus* with *tridactylus* of Europe; *Sphyrapicus nuchalis* and *ruber* with *varius*. On p. 588, vol II, speaking of *Conurus Carolinensis* and the singular confusion, still existing in regard to its breeding habits, etc., Prof. Baird remarks that "in view of their very limited area and rapid diminution in numbers, there is little doubt but that their total extinction is only a matter of years, perhaps to be consummated within the lifetime of persons now living."

The third volume begins with the Raptores, the systematic portion of which is by Mr. Ridgway. Here, again, many of the allied boreal forms of North America and Europe are united as geographical races of the same species, and in our opinion with great justice.* Fifteen species of owls are enumerated. It seems to be definitely settled that *Nyctale albifrons* Cassin is the young of *N. Acadica*. Three principal varieties of *Scops asio* are given: *Floridana*, *Maccalli* and *Kennicotti*. The dimorphic condition of this species and *Glaucidium ferrugineum* (as well as other extralimital species) is well compared to the melanistic state of certain hawks, in the one case reddish, in the other a more or less deep sooty brown being the color. *Spheotyto hypogæa* of North and Central America is given as a race of *S. cunicularia* of South America.

The Falconidæ comprise thirty-one species. The same general rule applies to the allied races of hawks as well as owls of Europe as compared with those of North America, namely, that in the latter the size is greater and the color much darker. This entire division is particularly interesting, many new facts in regard to the breeding habits, etc., of these birds, brought to light by several recent travellers in the Northwest, being published here for the first time. The synonymy of the North American gerfalcons

*For example, the following are now given as the specific names of certain of our species:— *Nyctale Tengmalmi* var. *Richardsoni*; *Nyctea Scandiaca* var. *arctica*; *Glaucidium passerinum* var. *Californicum*: *Falco lanarius* var. *polyagrus*: *F. communis* var. *anatum*; *F. lithofalco* var. *columbarius*; *Pandion haliætus* var. *Carolinensis*; *Circus cyaneus* var. *Hudsonicus*; *Astur palumbarius* var. *atricapillus*; *Aquila chrysaetus* var. *Canadensis*, etc.

is given as follows:—I. *Falco* (*Hierofalco*) *gyrfalco* Linn., var. *candicans* Gm. (= *Groenlandicus* Daud.) of Greenland, wandering into Europe and North America; II. var. *Islandicus* Sabine, of Europe, Iceland, Greenland and North America; III. var. *sacer*, Forster, of interior of continental Arctic America; IV. var. *Labradora* Aud.

On page 254, a figure of the curious *Onychotes Gruberi* Ridgw. is given. *Buteo oxypterus* is united to *Swainsoni*, and *B. elegans* to *lineatus*. The American rough-legged hawks (excepting the western *Archibuteo ferrugineus*) are given as one species, and that a variety (*Sancti-johannis*) of the European *A. lagopus;* the melanistic condition being now correctly regarded as a frequent though purely individual peculiarity, like albinism. *Haliætus albicilla* of Europe is included on account of its occurrence in Greenland. On page 329 it is stated that "the 'bird of Washington' of Audubon was, without the least doubt, a very large immature female (of the bald eagle) in about the second year." It is to be hoped that this question is now finally settled.

The true *Meleagris gallopavo* is described as inhabiting the eastern province of North America, with var. *Mexicana* found from Texas and Arizona south into Mexico. The latter race is now considered to be the origin of the domesticated turkey.

Canace Franklini is united to *Canadensis* as a variety; *C. fuliginosus* and *Richardsoni* to *obscurus;* and *Bonasa umbelloides* and *Sabini* to *umbellus*. Three species of Ptarmigan are enumerated:—I. *Lagopus mutus* var. *rupestris* of Arctic America, Greenland and Iceland; II. *L. albus*, common to Europe and North America; III. *L. leucurus* of Northwest America. Audubon's *L. Americanus* is united to the first species.

In the Appendix are given a number of new facts in regard to the habits, distribution, and synonymy of species previously considered, and one or two new species are added, as *Harporhynchus Bendirei* Coues, *Setophaga picta*, *Peucæa carpalis* Coues, etc. It may here be remarked that while certain species are noted as having been obtained in Europe, as *Galeoscoptes Carolinensis*, *Dendroica virens*, *Progne subi*, *Loxia leucoptera*, *Sturnella magna*, etc., similar mention is made of others whose claims to such notice are equally good, as *Turdus migratorius*, *Coccygus Americanus*, *Harporhynchus rufus*, *Regulus calendula*, and a few others. A glossary of technical terms closes the volume.

In concluding this imperfect sketch we would only add that for years this will be the standard work on the ornithology of North America, and that the volume or volumes on "Water Birds" will be looked for with much interest by students and others interested in the birds of our country.—J. S. Merrill.

BOTANY.

Distribution of Alpine Plants.—M. De Candolle delivered at the late Botanical Congress at Florence a communication on the causes of the distribution of rare plants on the Alps. The author (M. De Candolle) explained that the preglacial Alpine flora was not able to exert a great influence on the existing flora, inasmuch as the great changes which took place during the glacial period had necessarily swept away this ancient vegetation. He could not agree with those who considered the Alps as a centre of diffusion of a special flora, but believed them rather to be the refuge ground for the plants, which, as the glaciers retired, had found conditions more favorable to their existence than in places lower down. In proof of this he observed that the richest parts of the Alps for rare plants are those which were soonest deprived of glaciers, the ground having been thus cleared for the introduction of a more ancient flora, of which these rare plants are remnants. The southern, the eastern, and the western slopes of the Alps were successively cleared of the principal glaciers, and the Swiss Alps received their flora first from the south, and then from the east and west. The author then asks, "Why should the plants ascend as the glaciers retreat, and why should there be greater variety in this advancing vegetation?" In preglacial times there was more moisture in the climate of Europe, and consequently the flora was richer and more varied. After a time the climate became drier, and as the glaciers retired many plants were able to maintain themselves by advancing gradually over the ground as it became unoccupied by glaciers, finding there conditions more favorable for their growth. Hence one can deduce the law that the richness and variety of Alpine floras depend on the antiquity of their introduction.

Mr. Ball approved of M. De Candolle's theory to a certain extent, but he did not consider it sufficient to explain all the facts. When, for instance, a rare species is to be found in more than

one locality, it is natural to suppose that formerly it had occupied all the intermediate ground, and that the glacier coming through the midst of it had divided it into two groups. He was also unable to understand how M. De Candolle's theory could explain the fact of certain plants growing vigorously in limited spots without extending their area, and was inclined to attribute this limitation to the nature of the rock, its chemical properties, etc., —serpentine, for instance, almost always supports a peculiar vegetation; thus the Engadine Valley, which must have very recently been freed from glaciers, is remarkably rich in rare plants.— M. Tchiatcheff remarked that in Asia Minor he could find no trace of glacial action which could help to explain the distribution of Alpine plants.— *Journal of Botany.*

Amount of Water Contained in the Different Parts of a Plant.— At the same meeting M. Galeznoff gave the result of his researches in calculating the amount of water contained in the different parts of a plant. By dividing a trunk into a number of pieces from the base upwards, he found invariably that the quantity of water increases from the base towards the summit. Of the four species studied by him, he found *Pinus sylvestris* contained most moisture in the trunk, and Acer the least. Betula and *Populus tremula* were intermediate. In Pinus the bark is drier than the wood, and in Acer more moist. In Betula it is drier in the winter and spring, and more watery in summer and autumn. The contrary takes place in the case of the poplar. In the branches the same law holds good but their bases are drier than the portion of the trunk from which they take their rise; and the petioles are more watery than the leaves. In the flowers, the perianth, the filaments and the styles contain more water than the anthers. — *Journal of Botany.*

ZOOLOGY.

Recent Researches on Termites and Stingless Honey-bees. —The accompanying letter, just received from Fritz Müller, in southern Brazil, is so interesting that it appears to me well worth publishing in "Nature." His discovery of the two sexually mature forms of Termites, and of their habits, is now published in Germany; nevertheless few Englishmen will have as yet seen the account.

In the German paper he justly compares, as far as function is concerned, the winged males and females of the one form, and the wingless males and females of the second form, with those plants which produce flowers of two forms, serving different ends, of which so excellent an account, by his brother, Hermann Müller, has lately appeared in "Nature."

The facts, also, given by Fritz Müller with respect to the stingless bees of Brazil, will surprise and interest entomologists.—CHARLES DARWIN.

"For some years I have been engaged in studying the natural history of our Termites, of which I have had more than a dozen living species at my disposition. The several species differ much more in their habits and in their anatomy than is generally assumed. In most species there are two sets of neuters, viz., laborers and soldiers; but in some species (*Calotermes* Hag.) the laborers, and in others (*Anoplotermes* F. M.) the soldiers, are wanting. With respect to these neuters I have come to the same conclusion as that arrived at by Mr. Bates, viz., that, differently from what we see in social Hymenoptera, they are not modified imagos (sterile females), but modified larvæ, which undergo no further metamorphosis. This accounts for the fact first observed by Lespès, that both the sexes are represented among the sterile (or so-called neuter) Termites. In some species of *Calotermes* the male soldiers may even externally be distinguished from the female ones. I have been able to confirm, in almost all our species, the fact already observed by Mr. Smeathman a century ago, but doubted by most subsequent writers, that in the company of the queen there lives always a king. The most interesting fact in the natural history of these curious insects is the existence of two forms of sexual individuals, in some (if not in all) of the species. Besides the winged males and females, which are produced in vast numbers, and which, leaving the termitary in large swarms, may intercross with those produced in other communities, there are wingless males and females which never leave the termitary where they are born, and which replace the winged males or females, whenever a community does not find in due time a true king or queen. Once I found a king (of a species of *Eutermes*) living in company with as many as thirty-one such complemental females, as they may be called, instead of with a single legitimate queen. Termites would, no doubt, save an extraordinary amount of labor if, instead of raising annually myriads of winged males and females, almost all of which (helpless creatures as they are) perish in the time of swarming without being able to find a new home, they raised solely a few wingless males and females, which, free from danger, might remain in their native termitary; and he who does not admit the paramount importance of intercrossing

must, of course, wonder why this latter manner of reproduction (by wingless individuals) has not long since taken the place through natural selection of the production of winged males and females. But the wingless individuals would of course have to pair always with their near relatives, whilst by the swarming of the winged Termites a chance is given to them for the intercrossing of individuals not nearly related.

From Termites I have lately turned my attention to a still more interesting group of social insects, viz., our stingless honey-bees (Melipona and Trigona). Though a high authority in this matter, Mr. Frederick Smith, has lately affirmed that "we have now acquired almost a complete history of their economy," I still believe that almost all remains to be done in this respect. I think that even their affinities are not yet well established, and that they are by no means intermediate between hive- and humble-bees, nor so nearly allied to them as is now generally admitted. Wasps and hive-bees have no doubt independently acquired their social habits, as well as the habit of constructing combs of hexagonal cells, and so, I think, has Melipona. The genera Apis and Melipona may even have separated from a common progenitor, before wax was used in the construction of the cells; for in hive-bees, as is well known, wax is secreted on the ventral side: in Melipona on the contrary, as I have seen, on the dorsal side of the abdomen; now it is not probable that the secretion of wax, when once established, should have migrated from the ventral to the dorsal side, or *vice versâ*.

The queen of the hive-bee fixes her eggs on the bottom of the empty cells; the larvæ are fed by the laborers at first with semi-digested food, and afterwards with a mixture of pollen and honey, and only when the larvæ are full grown, the cells are closed. The Meliponæ and Trigonæ, on the contrary, fill the cells with semi-digested food before the eggs are laid, and they shut the cells immediately after the queen has dropped an egg on the food. With hive-bees the royal cells, in which the future queens have to be raised, differ in their direction from the other cells; this is not the case with Melipona and Trigona, where all the cells are vertical, with their orifices turned upward, forming horizontal (or rarely spirally ascending) combs. You know that honey is stored by our stingless bees in large, oval, irregularly clustered cells; and thus there are many more or less important differences in the structure, as well as in the economy, of Apis and Melipona.

My brother, who is now examining carefully the external structure of our species, is surprised at the amount of variability which the several species show in the structure of their hind legs, of their wings, etc., and not less are the differences they exhibit in their habits.

I have hitherto observed here fourteen species of Melipona and Trigona, the smallest of them scarcely exceeding two millimetres

in length, the largest being about the size of the hive-bee. One of these species lives as a parasite within the nests of some other species. I have now, in my garden, hives of four of our species, in which I have observed the construction of the combs, the laying of the eggs, etc., and I hope I shall soon be able to obtain hives of some more species. Some of our species are so elegant and beautiful and so extremely interesting, that they would be a most precious acquisition for zoological gardens or large hot-houses; nor do I think that it would be very difficult to bring them to Europe and there to preserve them in a living state.

If it be of some interest to you I shall be glad to give you from time to time an account of what I may observe in my Melipona apiary. — *Nature.*

The European House Sparrow. — I regret very much that a naturalist generally so well informed as Dr. Coues, should aid in giving what my own observations compel me to believe to be an altogether wrong statement in regard to the house sparrow, published in the July number of the Naturalist. Dr. Coues admits that he was prejudiced against the sparrow from the beginning. He expected they would molest our native species; he was always opposed to their introduction, and he is now apparently only too glad to condemn them on the scantiest evidence. I submit that this is too important a question to be thus dismissed, especially by a gentleman like Dr. Coues, who has enjoyed no opportunity of knowing from his own observations whether the opinions he is so free to express are well founded or not.

The statement of Mr. Gentry I entirely discredit. I do not believe that the habits either of the house sparrow or of the robin, blue-bird and our native sparrows are different in Pennsylvania, from what they are in Massachusetts. I believe that if any evil has befallen these birds in Pennsylvania, Mr. Gentry does not assign the right cause and that the house sparrow is innocent. We have the sparrows in Boston in great abundance, and for six years I have day after day, summer and winter, closely watched them. They never molest, attack, or try to drive away any birds, except their own species, and that only from amatory influences. In such times the males are pugnacious against other males of their own species, but nothing more.

The females are not at all pugnacious under any circumstances. In Boston the robin has never been so abundant as it is this summer, and the sparrows certainly never seem so numerous.

They feed together, side by side, and the only molestation the robin experiences is that once in a while a sparrow steals the worm it has dragged from the ground. But the sparrow has to do this slyly, and to drive off a robin would be an undertaking simply absurd.

Then as to the native sparrows. If any one of these seems exposed to being driven off it would be our little amiable chipping sparrow. Before we had their European cousins this bird was hardly known as a visitant to our city. Now they have become abundant, in their season, and what is very remarkable, they seek out and keep company with the European. Any day you please, in summer, you may see the house sparrow and the chipping sparrow feeding together in close proximity and you will never see the former molest or interfere with his confiding companion.

As for the blue-birds, the boot is on the other leg. The blue-birds do molest and drive off the sparrow, and have been known to take possession of and keep boxes put up for and belonging to the sparrow. My friend, John R. Poor, Esq., of Somerville, had succeeded in introducing the house sparrow into his grounds, in the early spring of 1871. They had begun to build in the boxes put up for their homes, when blue-birds appeared and drove them off, and made use of their boxes!

As for the opinion expressed by Dr. Coues that the sparrow is not needed here, that the good they do is overrated, etc., I will not trespass upon your space now by seeking to controvert an opinion so utterly confronted by overwhelming evidence all around us. I will only refer him to the report of the French parliament based upon the most thorough investigations of Prévost, placing the sparrow at the head of the useful birds of France; to the testimony of George N. Lawrence as to their destruction of the measure-worm in New York, Brooklyn, Newark, etc., and to our own city forester of Boston, who can inform him, if he discredits my testimony, how the sparrows here did what man was unable to do in arresting the ravages of the *Orgyia leucostigma*.—Thomas M. Brewer.

Fish Culture in the Olden Time.— Most of the popular accounts of artificial fish breeding, and the artificial stocking of rivers with fish, state that this is a very new thing. May I call the attention of the readers of the Naturalist to the following

extract from Kalm's Travels. It will be remembered that at the suggestion of Linnæus, Peter Kalm was sent to North America "to make such observations and collect such seeds and plants as would improve the Swedish husbandry, gardening, manufactures, arts and sciences." He arrived at Philadelphia in Sept., 1748, and left the country early in 1751. He recorded his observations on nearly every conceivable subject, from "the way of eating oysters" and the "art of making apple dumplings" to the most interesting observations on society, politics, agriculture and natural phenomena and productions. The expenses of his trip were paid in part by the government of Sweden, in part by the University of Upsala, by societies and private subscription, Kalm himself contributing to the extent of his ability, "so that at his return he found himself obliged to live upon a very small pittance." I quote from the English translation of his travels, published in London in 1772. After speaking of the diminution of fish in various rivers, caused by "immoderate catching of them at all times of the year" and "the numerous mills on the rivers and brooks" whose dams prevent the fish from passing "up the river in order to spawn," he says (Vol. 1, p. 229):

"Mr. FRANKLIN told me, that in that part of *New England* where his father lived, two rivers fell into the sea, in one of which they caught great numbers of herrings, and in the other not one. Yet the places where these rivers discharged themselves into the sea were not far asunder. They had observed that when the herrings came in spring to deposit their spawn, they always swam up the river where they used to catch them, but never came into the other. This circumstance led *Mr. Franklin's* father, who was settled between the two rivers, to try whether it was not possible to make the herrings likewise live in the other river. For that purpose he put out his nets, as they were coming up for spawning, and he caught some. He took the spawn out of them and carefully carried it across the land into the other river. It was hatched and the consequence was that every year afterwards they caught more herrings in that river; and this is still the case. This leads one to believe that the fish always like to spawn in the same place where they were hatched, and from whence they first put out to sea; being, as it were, accustomed to it."

He had already said (p. 23) that "*Mr. Benjamin Franklin*, to whom *Pennsylvania* is indebted for its welfare, and the learned world for many new discoveries in electricity, was the first who took notice of me, and introduced me to many of his friends.

He gave me all necessary instructions and shewed me his kindness on many occasions." Here is another item that is of interest. While speaking of New York, and the oysters found there, he goes on (I, p. 187),—"LOBSTERS are likewise plentifully caught hereabouts, pickled much in the same way as oysters, and sent to several places. I was told of a remarkable circumstance about these lobsters, and I have afterwards frequently heard it mentioned. The coast of *New York* had already *European* inhabitants for a considerable time, yet no lobsters were to be met with on that coast; and though the people fished ever so often, they could never find any signs of lobsters being in this part of the sea; they were, therefore, continually brought in great well-boats from *New England*, where they are plentiful; but it happened that one of these well-boats broke in pieces at *Hellgate*, about ten *English* miles from *New York*, and all the lobsters in it got off. Since that time they have so multiplied in this part of the sea, that they are now caught in the greatest abundance."—WM. H. BREWER.

THE INFLUENCE OF THE NERVES UPON THE CHANGE OF COLOR OF FISH AND CRUSTACEA.—A change of color is observed in many fish. It may be rapid and intense, as in the chameleon, but lacking its variety. Pouchet studied this phenomenon in a fish-breeding pond in Concarneau, among species of Blennius, Gobius and Pleuronectidæ. In a former communication to the Academy of Science, Pouchet reported that this change of color of the surface of the fish, corresponding to the color of its surroundings, originated in the brain, and the impression was caused by the action of the surrounding medium upon the retina. With the extirpation of the eyes this power of the animal disappeared. The blinded pleuronectide receives a subdued tint which remains, whatever be the color of the surroundings. This neutral coloring seen upon the entire body may be called a paralysis of the pigment cells. Pouchet tried to prove the influence of the nerves upon the pigment cells in the following experimental manner. Young Pleuronectidæ that changed their color with rapidity were kept in a tank with a brown bottom; before severing the nerve they were put into another tank, the bottom of which was covered with sand; here the specimens operated upon became bleached. Except those portions especially influenced by the nerves, they retained their dark color. By separating the spinal cord no such

result was observed. When the trigeminal nerve was severed, all of the pigment cells on that side of the head supplied by it were paralyzed. The animal operated upon, kept in a tank with a sandy bottom, had a faded color, only a small portion of the head remained dark, a smaller or larger portion, depending upon how large a part of the trigemimus was severed. A corresponding result followed the separation of the spinal nerves. The course of the severed nerve was followed by a dark colored stripe; on the back of the pleuronectide, zebra-like lines were seen. The resultless severing of the spinal cord proves, that the influence that a spinal nerve has upon the coloring cells does not proceed from the spinal cord. The splanchnic and sympathetic nerves are then brought into question. The severing of the former gives no result. If on the contrary the sympathetic nerve is severed anywhere on the inferior portion of the vertebral canal, paralysis of all of the pigment cells of the skin occurs, posterior to the cut. The deep position of the fine delicate sympathetic nerve makes it impossible to divide without injuring the neighboring parts. The animal survives the operation two and three days. During this time it is half light and half dark colored. Similar trials made upon the inframaxillary nerve and artery, both of which lie superficially and are accessible, make it possible that the real nerve stem which regulates the movement of the pigment cells is not the one that accompanies the blood-vessel. Pouchet tried cutting the sympathetic nerve at its origin, behind the articulation of the suspensorium, but with such result as was anticipated. The length of time that the paralysis of the pigment cells lasts, after the nerve is severed, is not fully known; it has been found to remain some weeks as marked as at first. The paralyzed portions upon the surface of the body receive this mixed color, like the blind pleuronectidæ now dark, now light, according as the remaining portion of the skin is influenced by the surroundings. Poisoning the fish with curare, strychnine, morphine, veratria and sontonin has no especial influence upon the change of color.

The influence of habit was marked. A pleuronectide, that had lived a long time in a tank, the bottom of which was covered with sand, when removed to one with a brown bottom, remained four days before it fully received a corresponding color.

Pouchet noted his observations daily, and came to the conclusion that the change of color is at times influenced, but that the

origin of the same, is not yet well understood. At certain hours during the day, when it is cloudy for instance, those spots in the operated animals which were in a paralyzed state were scarcely to be perceived, and again in an hour or so later, they stood out in a very marked contrast, in color, to the rest of the skin, without the foundation color having changed.

The power of bringing the color into harmony with the surrounding medium among the crustacea, was remarkably shown in the *Palæmon serratus*. Animals from three to four centimetres long are the best to experiment upon, placed in porcelain vessels with black or white bottoms. The crabs that fishermen bring ashore have a rose or a dark lily color; if they are put into vessels with black or white bottoms in twenty-four hours, they will assume a color wholly unlike each other. Those in the white dish are yellowish, almost colorless, as if they had just shed their skin, and those in the dark colored dish are of a brown red color. When changed the pale one into the dark colored dish, and *vice versâ*, they change color in a corresponding manner. The change of a pale one to a dark color, was more rapid than the reverse. Under favorable conditions we can create a yellow, red and blue Palæmon. If a foot is removed when any one of these colors is present, and put into a solution of sugar, the three colors appear successively before the eye. The microscope reveals the sequel to this. If the pigment cells are pressed together like balls, then they are too minute to mirror themselves upon the retina. As soon as the animal is placed upon a dark ground the coloring cells are distended and send out little branches on all sides; then they become perceptible to the eye. The animal becomes red rose colored, when nothing weakens the lively color of the pigment cells; as the branches of the latter distend under the hypodermis they receive a cobalt color and the carmine of the pigment cells becomes thereby browned, and thus the Palæmon takes on a color corresponding to the foundation. If the coloring cells contract again, the blue remains six or seven hours in the hypodermis and then gradually disappears. With the Palæmon as with fish, the change of color is the result of visual impressions.

Among animals whose eyes Pouchet extirpated, a continuous dark color was observed and continued during the entire time, thirty-four days. By severing the nerves, an explanation of the phenomena was not attained.

Pouchet adds in conclusion, that in the eyeless crustacea, the pigment cells are wanting.— (*Translated* by Dr. MARY J. S. BLAKE *from Schmidt's Jahrbücher*, *No.* 9, 1872).

THE COTTON WORM.—I have already shown that this insect is first described and named scientifically by Hübner in 1822, as *Aletia argillacea* from Brazil. It is an inhabitant of more southern latitudes than the cotton belt of the Southern States. I have shown that the insect is found during the winter as a moth, not from "analogy," but fact. I have also shown that the insect dies out in the central and northern portions of the cotton belt every year, and is replaced the succeeding year by immigration from more southern localities, and where the cotton plant is perennial. Prof. Glover's observations on the moth seem to me to be generally correct and reliable; on the other hand, Prof. Riley's remarks in the Sixth Missouri Report are, where Prof. Glover is contradicted, a "too hasty generalizing," and show nowhere any original acquaintance with the subject. The moths have been collected by Prof. Packard on an island in Salem harbor, Mass.; and by Mr. Burgess in Massachusetts Bay, flying over the water, and by myself about Buffalo, N. Y. The worm never attacks the young cotton in Central Alabama in the spring or early summer, but appears at its earliest at the end of June, and is invariably preceded by flights of the adult moth. Since in Central Alabama insect life begins as early as March (and before then the "hybernated" cotton moth has disappeared) what is the *Aletia argillacea* doing between that date and July, when the worm appears? And why is the young cotton not attacked in May by the worms from the eggs deposited by the "hybernating" moths? If the "hybernating" moths lay eggs, their progeny perish from lack of food. But many chrysalides are killed by frost, and there is great irregularity about the completion of the final brood of moths arising from the age of the insect and the approach of the winter.—A. R. GROTE.

LARVÆ OF ANOPTHALMUS AND ADELOPS.—The larvæ and pupa of Anopthalmus, from Salt cave near Mammoth, were discovered in May last by Mr Sanborn and myself while engaged in exploring the caves of Kentucky under the auspices of the Geological Survey of Kentucky. The larvæ of Anopthalmus were found running under stones on the sand in damp situations in company with the beetles, while the pupæ were found lying in little oval

holes in the same situation and at the same date. The larva is more closely allied to that of *Pterostichus nigrita*, figured by Schiödte, than any I have seen figured. The body, however, is rather slenderer, the head much longer and narrower, and the mouth parts longer, while the caudal appendages are shorter. The end of the body is like that of Harpalus and Stenolophus as figured by Schiödte, but the form of the mandibles is more like that of Harpalus. There are no eyes, and the body is white and soft, not chitinous as in Carabid larvæ generally. There is no sculpturing on the head or thoracic segments.

The larvæ of *Adelops hirtus* has a body somewhat like that of Agathidium, but the head is very much larger and as wide and long as the prothoracic segments. It is white, and I can perceive no eyes. The body tapers rapidly from the prothorax to the end, and is provided with long hairs. The antennæ are large and long. The larvæ of these beetles have not yet been discovered in Europe. —A. S. Packard, Jr.

New Variety of Blue Grosbeak.—Several Mexican examples of *G. cærulea* examined, uniformly differ from the United States bird in the following particulars: they are larger; wing 3·70 instead of 3·40, tail 3·00, as against 2·70; total length about 7·00. The bill, in particular, is notably larger every way, and especially deeper, with a more swollen upper mandible and more curved ridge. Length of culmen 0·70, extreme depth about the same; in *G. cærulea*, culmen 0·60, depth decidedly less. It is mostly light brownish horn-color, instead of mostly blackish. I see no difference in the plumage. This appears to be the resident Mexican form, and to be quite as "good" a variety as many of those now current. It may be termed *G. cærulea* var. *eurhyncha*.—Elliott Coues.

Dimorphism in Gall Flies.—Mr. H. F. Bassett (Canadian Entomologist, v, 91) states that *Cynips q. operator* is double brooded; thirty of one brood of females ovipositing in the buds of the oak, and again some of a second brood ovipositing in the young acorns of *Quercus ilicifolia*. From these and other facts he infers "that all our species that are found only in the female sex are represented in another generation by both sexes, and that the two broods are, owing to seasonal differences, produced from galls that are entirely distinct from each other." This confirms Walsh's discovery of dimorphism in the Cynips (see Amer. Ent. ii, p. 320).

SWEET SCENTED ANTS.*—I have just returned from Mr. A. J. Lauderdale's, where I had been on a visit of inquiry in reference to the sweet ants. The whole family were present, and all declare that they have often smelt them, when by accident, in their nocturnal visits, one would get crushed under foot. They have also captured them and smelt their sweet perfume when crushed between the fingers. Capt. Lauderdale states that the odor which the ants emitted on being crushed surpassed in sweetness any perfumery he had ever seen; that he had repeatedly searched for them since he evacuated the place, without success; that the horticultural ants had, since the house was left unoccupied, filled up the fireplace with bushels of sand; and gave it as his opinion that they had driven off the fragrant ants. My son examined them and pronounced it the sweetest odor he had ever experienced.

These ants are extremely rare, but that they do exist there is but little doubt.—GIDEON LINCECUM, *Long Point, Texas.*

ROBBER ANTS.*—Once upon a time there dwelt in my yard a flourishing colony of the very smallest species of black ant. The servants about my cook house had spilt a quantity of syrup which run through the floor. The little ants had found it, and seemingly the entire population were out and busy packing it away to their home.

The microscope showed that they carried the syrup in their abdomen. But before they had secured all the syrup, I observed there was great excitement along their road. The larger, black, erratic ants had discovered them while carrying home the syrup, and were taking it away from them. It was really painful to observe the ruthless manner in which they slaughtered and robbed the helpless little ants of their distended sacks of sweetness.

They grabbed up the heavily burdened little fellows, doubled them, and, biting open the abdomen, drew out the full sack and seemed to swallow it; then, casting the lacerated carcass aside, they furiously sprang upon another of the panic-stricken crowd and repeated the horrid operation. Millions of these heartless butchers were at work; and soon, *on account of their wealth*, that populous city was exterminated.—G. LINCECUM.

ICHNEUMON PARASITES OF ANTHRENUS LARVÆ.—We have received from Mr. E. S. Cassino two small ichneumon larvæ found

*Communicated in a letter to the Smithsonian Institution, and published by permission of Professor Henry.

on July 30th in that of the Anthrenus. We are not aware that this destructive museum pest is known to be thus affected.

Larvæ of Membracis serving as milk cattle to a Bee.—Fritz Müller has observed in Brazil a larva of a leaf-hopper (*Umbonia indicator* Fairm.) which is used, like the Aphides by the ants, as milch cattle by a species of stingless bee (*Trigona cagafogo* Müll.) This bee is fond of oily matters, and feeds on carrion, old stinking cheese and oil secreted by various plants. Although stingless, it possesses a very intense venom, which causes a most lively irritation in the skin.

ANTHROPOLOGY.

A true Geography of the Brain.—It has until lately been supposed that the convolutions of the cerebrum are entirely concerned in purely intellectual operations, but this idea is now at an end. It is now evident, from recent researches, that in the cerebral convolutions—that is, in the part of the brain which was believed to minister to intellectual manifestations—there are nerve-centres for the production of voluntary muscular movements in various parts of the body. It has always been taught that the convolutions of the brain, unlike nerves in general, cannot be stimulated by means of electricity. This, although true as regards the brains of pigeons, fowls, and perhaps other birds, has been shown by Fritsch and Hitzig to be untrue as regards mammals. These observers removed the upper portion of the skull in the dog, and stimulated small portions of the exposed surface of the cerebrum by means of weak galvanic currents, and they found that when they stimulated certain definite portions of the surface of the convolutions in the anterior part of the cerebrum, movements are produced in certain definite groups of muscles on the opposite side of the body. By this new method of exploring the functions of the convolutions of the brain, these investigators showed that in certain cerebral convolutions, there are centres for the nerves presiding over the muscles of the neck, the extensor and adductor muscles of the forearm, for the flexor and rotator muscles of the arm, the muscles of the foot, and those of the face. They, moreover, removed the portion of the convolution on the left side of the cerebrum, which they had ascertained to be the centre for the movements of the right forelimb, and they found

that after the injury thus inflicted, the animal had only an imperfect control over the movements of the part of the limb in question. Recently Dr. Hughlings Jackson, from the observation of various diseased conditions in which peculiar movements occur in distinct groups of muscles, has adduced evidence in support of the conclusion that in the cerebral convolutions are localized the centres for the production of various muscular movements. Within the last few months these observations have been greatly extended by the elaborate experiments of my able colleague in King's College, Prof. Ferrier.

Adopting the method of Fritsch and Hitzig—but instead of using galvanic he has employed Faradic electricity, with which, strange to say, the investigators just mentioned obtained no very definite results—he has explored the brain in the fish, frog, dog, cat, rabbit and guinea-pig, and lately in the monkey. The results of this investigation are of great importance. He has explored the convolutions of the cerebrum far more fully than the German experimenters, and has investigated the cerebellum, corpora quadrigemina, and several other portions of the brain not touched upon by them. There is, perhaps, no part of the brain whose function has been more obscure than the cerebellum. Dr. Ferrier has discovered that this ganglion is a great centre for the movements of the muscles of the eyeballs. He has also very carefully mapped out in the dog, cat, etc., the various centres in the convolutions of the cerebrum, which are concerned in the productions of movements in the muscles of the eyelids, face, mouth, tongue, ear, neck, fore and hind feet, and tail. He confirms the doctrine that the corpus striatum is concerned in motion, while the optic thalamus is probably concerned in sensation, as are also the hippocampus major and its neighboring convolutions. He has also found that in the case of the higher brain of the monkey there is what is not found in the dog or cat—to wit, a portion in the front part of the brain, whose stimulation produces no muscular movement. What may be the function of this part, whether or not it specially ministers to intellectual operations, remains to be seen. These researches of Fritsch, Hitzig, Jackson, and Ferrier, mark the commencement of a new era in our knowledge of brain function. Of all the studies in comparative physiology there will be none more interesting, and few so important, as those in which the various centres will be mapped out in the brains throughout the vertebrate

series. A new, but this time a true, system of phrenology will be founded upon them; by this, however, I do not mean that it will be possible to tell a man's faculties by the configuration of his skull, but that the various mental faculties will be assigned to definite territories of the brain, as Gall and Spurzheim long ago maintained, although their geography of the brain was erroneous.—Prof. RUTHERFORD *in Nature*.

Dr. Brown Sequard has called in question the conclusions given above in lectures delivered in Boston last March.

RATE OF GROWTH IN MAN.—In an interesting account of the life and works of the late Belgian anthropologist and statistician, Adolphe Quetelet, published in "La Revue Scientifique," occur the following remarks on the rate of growth in man. "The most rapid growth takes place immediately after birth; the infant in the space of a year grows about two decimetres.* The increase in size diminishes gradually as its age increases, up towards the age of four or five years; when about three it attains half the size which it is to become when full-grown. When from four to five years of age the increase in size is very regular each year up to sixteen years, that is to say up to the age of puberty; this annual increase is nearly fifty-six millimetres. After the age of puberty the size continues to increase, but feebly; when from sixteen to seventeen years old the individual increases four centimetres (·60 inch). In the two years following, it increases only one inch. The total increase in size of man does not appear to be entirely terminated when he is twenty-five years old. The mean size is a little larger in cities than in the country."

MICROSCOPY.

NEW ROTATING MICROSCOPE.—Mr. Browning has introduced into England the continental fashion of attaching the bar of the microscope to the stage which is made to revolve carrying the body with it. This, of course, gives a rotating stage without any difficulty in regard to centring. Any tremor, also, connected with the revolving apparatus is common to the object and the magnifying apparatus, and is therefore of little consequence. For objects illuminated from below, this arrangement is prac-

*A decimetre is one-tenth of a metre, amounting to nearly four inches.

tically as good as the more difficult and expensive plan of rotating the stage only; though for objects illuminated from above it is less convenient. It is also made binocular.

MOUNTING DIATOMS.—It is due to Dr. Christopher Johnston of Baltimore, to say that I am indebted to his very valuable paper, on the "Preparation of Diatomaceæ" for the method of retaining the diatoms in place, mentioned in my note. If dry mounting is preferred, I have found by experiment, that the diatoms may be arranged as before stated on the cover, without the gelatine coat, and fixed in place by moistening with vapor as before stated. This plan has some advantages for real study.—W. W. RINER.

BLOOD CRYSTALS.—The detection of blood by finding its crystals is a much easier process than has been thought, and is also much more generally applicable. In blood decomposed, or that has been treated by acids or caustic alkali, hæmoglobin is changed into a new substance; hæmatin is formed, which, combined with hydrochloric acid, gives characteristic crystals. In order to obtain them we must proceed thus: A small fragment of dried blood is placed on a slide; it is dissolved in a drop of water, and a minute portion of sea-salt is added. It is covered with a thin slide, and pure acetic acid is made to pass between the two slides, and it is heated over a spirit-lamp to boiling point. Acetic acid is again added, and it is heated afresh; this is repeated till the crystals are obtained. They are rhomboidal, of a dirty brown color, quite characteristic, and require to be seen with a magnifying power of three hundred or four hundred diameters. With the smallest quantity of blood this reaction can always be produced.—*Popular Science Review.*

TOLLES' NEW IMMERSION $\frac{1}{8}$TH.—About three weeks since I received from Mr. R. B. Tolles a $\frac{1}{8}$th immersion objective, similar to the one purchased by Mr. Crisp of London (see M. M. J. for March 1874). Mr. Tolles claims for this objective an angle of 180° in air and about 100° in balsam. Simple appliances at my command demonstrate I think conclusively that this glass will receive and convey to the eye "image-forming rays" incident to the front surface of front lens at an angle of 10° = aperture of 160. The performances of this new $\frac{1}{8}$th are at once novel and remarkable, on *Amphipleura pellucida* (dry) it shows the transverse

striæ with singular beauty. The "lines" appearing to shine with golden lustre. Specimens of *Frustulia saxonica* (very small) that have persistently defeated a fine modern $\frac{1}{16}$th in my possession, my Tolles wet $\frac{1}{10}$, as also a $\frac{1}{15}$th belonging to a friend, surrender at once to this $\frac{1}{6}$th giving strong transverse striæ. The markings of *Surriella gemma* (dry mounted) are shown very strongly. Either as dots or hexagons, mounted in balsam the markings are much stronger than I have before seen with any lens. The behavior of this $\frac{1}{6}$th over *Cymatopleura elliptica* excited my unqualified admiration. In short "this most interesting glass," goes satisfactorily through my collection of test diatoms. The illumination used was (for the most part) from a German student's lamp. The maximum performance of the $\frac{1}{6}$th is obtained by working through a thick cover, say $\frac{1}{75}$th of an inch; with such a cover the objective works well dry, using central or nearly central light. Perhaps the most valuable property of the new $\frac{1}{6}$th will be recognized in its superior performances by centrally disposed light. With the experience I have had of the $\frac{1}{6}$th in this direction I am forced to the conclusion that these new system glasses of Mr. Tolles will become equally valuable to histologists and diatomists. — J. Edwards Smith, *Ashtabula, O., July*, 1874.

NOTES.

The Hartford Meeting of the American Association for the Advancement of Science was in several ways a great success. The register exhibited the names of about 225 old members who were present, and 118 new members were elected. 165 papers were entered, ten of which were not passed by the Standing Committee for the want of abstracts, and twenty others were either withdrawn by their authors or declined by the Sectional Committees, leaving sixty-six papers in Section A, and sixty-nine in Section B. Of those in Section B, ten were given by title only, and the rest were read by their authors before the section or proper subsection, and were more or less discussed. Section A formed a subsection of chemistry on Monday afternoon, which was very strongly represented and held its session until Tuesday evening. The additional interest taken by the chemists in the Hartford meeting was undoubtedly owing to the resolutions passed at Northumberland, by which they declared that it was unadvisable to form a separate

society, and agreed to enter the Association and establish a permanent subsection. Their action in this respect cannot be too heartily endorsed by the scientists of the country, for it is just such action, on the part of all the different bodies of scientific men that now annually meet independent of the Association, that is needed to make the American Association the great power in this country which the British Association has become in England by the united efforts of all persons interested in the advancement of science. We feel confident that it will not be long before the Association of Mining Engineers will realize the advantages to be secured by uniting with the American Association, especially as under the new constitution they could organize, as the chemists have done, as a permanent body. The entomologists were present in goodly numbers, and while taking an active part in the meetings of Section B, they also organized as a club and held separate evening meetings, under the name of the Entomological Club of the American Association. From much that was said and done at the recent meeting, it was very evident that a strong feeling has expressed itself over all parts of the country in favor of a united effort to make the future meetings of the American Association in every way the expression of the advancement of science in the country, and with this effort, which is simply the natural result of the growth of the Association, the process of absorbing all the smaller scientific bodies of a national character is only a matter of time. The botanical element was more largely represented at the Hartford meeting than we remember ever to have noticed before, and now that the impetus has been given it is very reasonable to expect large additions from the botanical ranks at the future meetings. The geologists were as usual well represented and formed a subsection for Monday and Tuesday, with Prof. J. D. Dana in the chair. There were also more papers bearing on general zoological questions this year than for several past meetings, and Anthropology was made prominent by a number of quite interesting communications. On Monday Section B subdivided into Biology and Geology and continued to hold its meetings in subsections until Tuesday evening, when it held its final session with the exception of a very short one on Wednesday morning.

The older members were largely represented at this meeting, and a noticeable feature was the attendance of a number of past presidents of the Association. Under this head we recall Prof.

W. B. Rogers who ranks as the first president, he being in office when the Association was formed by the enlargement of the older Association of Geologists and Naturalists. The presence of Prof. Rogers was greeted with joy, as his health has prevented his taking his former active part in the meetings for several years. Professors Joseph Henry, J. D. Dana, F. A. P. Barnard, B. A. Gould, T. Sterry Hunt, Asa Gray, J. Lawrence Smith, and the retiring president, Prof. Joseph Lovering, were also present.

The address of the retiring President gave universal satisfaction, and though bearing more on the section to which he specially belongs than to Section B, we feel that all our readers will be glad to have us follow our course for several years and present it to them in the following numbers of the NATURALIST.

The social element of the meeting was well developed, and though there was very little private entertainment given to the members by the residents, there was a large number of citizens who, as the Local Committee, took an active interest in the Association, and in many ways made the meeting a very pleasant one. The only levee given to the Association was by Dr. Stearns on Thursday when a very enjoyable evening was passed. Several special invitations were received from the managers of the various institutions and large establishments in and about Hartford, and most of them were very generally accepted by members, and many very interesting works were visited. The special excursions arranged by the Local Committee were well planned and admirably carried out. The steamer excursion down the Connecticut to its mouth and return, on Saturday, was a perfect one and was greatly enjoyed by the several hundred persons who passed the day on the river; while the geologists, and all others who wished to go, had their full share in the several afternoon excursions to Tariffville and the Portland quarries; and all who went on the afternoon excursion to Cheneyville could only have experienced great pleasure at the sight of this model and beautiful little village, where the silkworm's slender threads are unwound and woven into substantial fabrics and gay ribbons. On Thursday, the day following the adjournment, a very interesting excursion took place, and consisted of a trip through the most beautiful portion of the State to Lakeville and the iron mines of Salisbury.

As was expected, a large amount of time was occupied in discussions relating to the new constitution, but as this very import-

ant matter was finally settled to the perfect satisfaction of all concerned, it was time well spent, and it is now believed that the future of the Association is firmly established on a basis that is fully adapted to the work it is to perform. The acceptance of the Act of Incorporation also gives an important legal existence to the Association which will add greatly to its power. The officers for the next meeting were elected under the new constitution, and very great additions to the interest and importance of the future meetings are expected from the addresses of the Vice-Presidents and the Permanent Chairmen of subsections. An important addition to the Standing Committee is also secured by the new constitution, as under it the past Presidents are now life members of the Committee; and the Secretaries, as well as the Chairmen of the sections, will be members of the Committee. In this way, the Committee becomes a much larger body, consisting of the veterans of American Science as well as the active officers of the Association, and will be fully capable of performing the important work that devolves upon it. It is also believed that by the election of the Secretaries of the sections a year in advance they will fully realize the importance of the position and the responsibilities which they accept.

The very cordial invitation which came from Detroit for the Association to hold its next meeting in that city, was so warmly tendered by the Governor of the State, the Mayor of the city, and the Detroit Scientific Society, that it was impossible for the Association to do anything but accept, and it was unanimously voted to hold the next meeting in Detroit, beginning on the second Wednesday in August, 1875.

The following were elected as the officers for the next meeting: *President*, J. E. Hilgard, of Washington; *Vice President of Section A*, H. A. Newton, of New Haven; *Vice President of Section B*, J. W. Dawson, of Montreal; *Chairman of Chemical Subsection*, S. W. Johnson, of New Haven: *Permanent Secretary for five years*, F. W. Putnam, of Salem; *General Secretary*, Samuel H. Scudder, of Boston; *Treasurer*, W. S. Vaux, of Philadelphia; *Secretary of Section A*, S. P. Langley, of Allegheny, Pa.; *Secretary of Section B*, N. S. Shaler, of Newport, Ky.

The officers of Section B, Natural History, for the Hartford meeting were:—*Permanent Chairman*, Mr. S. H. Scudder, of Cambridge; *Secretary*, Prof. Theo. Gill, of Washington; *Sectional*

Committee, Prof. S. F. Baird, of Washington; Prof. E. T. Cox, of Indianapolis; Prof. T. Sterry Hunt, of Boston.

Subsection of Biology. *Chairman*, Rev. Dr. E. A. Dalrymple, of Baltimore; *Secretary*, Mr. W. W. Bailey, of Providence. Subsection of Geology. *Chairman*, Prof. James D. Dana, of New Haven; *Secretary*, Prof. E. W. Hilgard, of Ann Arbor.

The following is a list of the papers read in Section B:—

The Genera of Butterflies studied historically, by Samuel H. Scudder.
Discovery of twelve skeletons of *Dicotyles compressus* in the Valley Drift in Columbus Ohio, by John H. Klippart.
Present distribution of woodlands within the United States, by William H. Brewer.
Further Contributions to Physiographic Geology, by Richard Owen.
Change by Gradual Modification not the Universal Law, by Thomas Meehan.
On the Cotton Worm (*Aletia argillacea* Hübn), by Aug. R. Grote.
On *Sarracenia variolaris* as a Fly Catcher, by Dr. J. H. Mellichamp.
Darlingtonia Californica, an Insectivorus Plant, by Wm. H. Canby.
The Lobster, by W. W. Wheildon.
On the Insects more particularly associated with *Sarracenia variolaris* (Spotted Trumpet leaf), by C. V. Riley.
On the Summer Dormancy of the Larvæ of *Phyciodes nycteis* Doubleday, with Remarks on the Natural History of the Species, by C. V. Riley.
Further observations on the Geology of Northwestern Massachusetts, with special reference to the Hoosac range, by Sanborn Tenney.
Botanical Observations, by Wm. H. Seaman.
Glacial Phenomenon in the Sierra Nevada, by John Muir.
Cremation among North American Indians, by John L. LeConte.
Instance of Replacement of Injurious insects by Human agency, by J. L. LeConte.
Geological Map of the United States and Territories, with Critical and Explanatory descriptions, by Prof. C. H. Hitchcock and Wm. P. Blake.
On Regeneration or Organic Molecular Conservation: a contribution to the doctrine of evolution, by Louis Elsberg.
On the Habits and Transformations of *Canthon Hudsonius* (Forst.) the common "Tumble-dung," by Charles V. Riley.
On the Larval Habits of the Cantharid genera *Epicauta* and *Henous*, by C. V. Riley.
On the Origin of North American Unionidæ, by Edward S. Morse.
On the Relations of Dentalium, by E. S. Morse.
On the Cave Fauna of the Middle States, by A. S. Packard, Jr.
Remarks on the Anderson School of Natural History, by F. W. Putnam.
On the Male and Female organs of the Sharks, with special reference to the use of the "Claspers," by F. W. Putnam and S. W. Garman.
On the Composition of the Pottery of the Mound-builders, by E. T. Cox.
A Remarkable Ancient Stone Fortification in Clarke County, Ind., by E. T. Cox.
Progress of Science in Maryland, by Mrs. Almira Lincoln Phelps.
Correction of previous description of the net of Hyptiotes, by Burt G. Wilder.
Note on the gestation of the little Brown Bat, by B. G. Wilder.
The relations of Amphioxus to the Marsipobranchs especially as indicated chiefly by a diagrammatic view of their respiratory apparatus, by B. G. Wilder.
The relations of the Vertebrate Classes as indicated by a tabular arrangement of their characters, constant, peculiar, and more or less common, by B. G. Wilder.
Physical History of New Hampshire, by C. H. Hitchcock.
The morphological significance and taxonomic value of the rectal pouch of Selachians (Elasmobranchs), by B. G. Wilder.
On the Significance of Classes among Vertebrates, by Theo. Gill.

On the Characters and Relations of the American Genera of Cervidæ, by Theo. Gill.
On the Relations of Certain Genera of Cervidæ, by Theo. Gill.
List of the Vertebrate Animals of Outagamie Co. Wis. with notes, by D. S. Jordan.
Remains of an ancient earth work in Marblehead, Massachusetts, by J. J. H. Gregory.
Examination of forty-five Indian graves found in Marblehead, by J. J. H. Gregory.
Notes on some rare and interesting Carices of New York, by Geo. Vasey.
On the ascending process of the Astragalus in Birds, by Edward S. Morse.
Organ of Special Sense in the Lamellibranchiate genus Yoldia, by Wm. A. Brooks.
Notes on Tree Growth, by Asa Gray.
On the Disintegration of Rocks and its Geological Significance, by T. S. Hunt.
Equivalency of the Coal Measures of the United States and Europe, by C. A. White.
The Physical and Geological Characteristics of the Great Dismal Swamp and the Eastern Counties of Virginia, by N. B. Webster.
On the True Character of the so-called Eozoon Canadense, by L. S. Burbank.
Notes on Natural Erosion by Sand in the Western territories, by G. K. Gilbert.
The Recency of certain Volcanoes of the Western U. S., by G. K. Gilbert.
The Colorado Plateau Region as a field for geological studies, by G. K. Gilbert.
Small size of the brain in Tertiary Mammals, by O. C. Marsh.
Ancient Lake Basins of the Rocky Mountains, by O. C. Marsh.
The Wings of Pterodactyls, by O. C. Marsh.
On the Mechanical Condition of the Pebbles in the Newport Conglomerate and their supposed flattening by pressure, by Wm. B. Rogers.
On the Thickness of the Virginia Tertiary, as indicated by the Artesian borings at Fortress Monroe, by Wm. B. Rogers.
Notes on the Palæozoic Formations of South America, by O. A. Derby.
On the Classification of the Indian Languages of Mexico, by Porter C. Bliss.
Observations in a visit to the Cave of Cachuamilpa, Mexico, by Porter C. Bliss.
An Ascent of the Volcano of Popocatepetl in Mexico, by Porter C. Bliss.
On the Organic Change produced in the Bee by the different conditions to which it is subjected in its Larval State, by Mrs. Sophie B. Herrick.
On contact of Trap and Sandstone in the Connecticut Valley, by Wm. N. Rice.
Origin of the Cascades of the Columbia River, Oregon, by Wm. P. Blake.
How do Young Birds peck out of the Shell? by J. W. P. Jenks.
On the Trap rocks of the Connecticut Valley, by Edward S. Dana.
An Inquiry Concerning the Reversion of Thoroughbred Animals, by W. H. Brewer.
Notice of a pair of Trap-door Spiders from South America, by Chas. R. Dodge.
Traces of Ancient Civilization in Mexico, by Porter C. Bliss.
Observations on the Mesozoic of North Carolina, by W. C. Kerr.

We have already given an account of Dohrn's zoological laboratory at Naples, and referred to the Anderson School of Natural History at Penikese, and the peripatetic laboratory annually set up by Prof. Baird in connection with the United States Fish Commission. In the January number of the "Archives de Zoologie Expérimentale," etc., M. Lacaze-Duthiers gives an interesting account of the "Laboratory of Experimental Zoology" established by him in 1872 at the suggestion of M. A. du Mesnil, director of the higher education under the minister of public instruction. It was opened on the coast at Roscoff, not far from Paris, and in a region zoologically rich. The funds devoted to the purpose were very small; the laboratory is a simple house on the seaside with five chambers and a pump to feed the aquaria; but judging by the

papers which have been published by Lacaze-Duthiers, Perrier and Giard, the amount of work done is greater so far as we are aware than at any other laboratory of the sort. An excellent feature of the "Laboratory of Experimental Science" is that it is not to be permanently established at one spot, but every five or six years will be moved from place to place until the marine fauna of France shall be thoroughly investigated. In this way a series of works will gradually be produced on the fauna of France.

There is still an opening in this country for just such schools as this, which combining general education and special research shall, in an inexpensive way, hold sessions of say, two months, extending over a few years at a time at different points along our coast. For example, the southern colleges could send professors and a few advanced students to Beaufort, N. C.; the Washington and Georgetown colleges could combine and have a summer session at Old Point Comfort; the Pennsylvania Colleges could rendezvous at Cape May, while the western and northern colleges could continue sending students to the Anderson School at Penikese. By mutual assistance and coöperation our extensive coast could be thoroughly explored and higher biological researches be carried on, as well as observations on the chemistry and physics of the sea.

The Anderson School of Natural History at Penikese Island closed on the 29th of August. Fifty students received instruction including laboratory work and lectures from ten professors, and the degree of attention given and amount of original work done was gratifying. The moral success of the school is established, and we hope that want of means will not prevent the plans of the late Professor Agassiz from being carried out. There is great need of a physiological laboratory, a fish pond and other conveniences, which in time we hope will be supplied.

The U. S. Engineers have a party in the field exploring the territories west of the 100th meridian, under Lt. Wheeler, U. S. A. Dr. H. C. Yarrow is the naturalist, and Prof. E. D. Cope the palæontologist of the expedition. The party started from Denver, Col., about July 20th. Collections will be made in all branches of Natural History. The expedition will return October 1st.

Dr. Ferdinand Stoliczka, the paleontologist to the geological survey of India, died in India at Shayok, June 19th, aged thirty-

six. A zoologist and geologist, his greatest work says "Nature," was his account of the fossil fauna discovered in the Cretaceous rocks of southern India.

THE number of visits paid during the year to the herbarium of the British museum for the purpose of scientific research, was 1020.

UPWARDS of 21,000 herbarium specimens have been received (chiefly presented) from all parts of the world at the herbarium of the Royal Gardens at Kew.

A NEW volume of Lacordaire's Genera of Coleoptera has lately appeared.

BOOKS RECEIVED.

Report of the Chief of Engineers for 1872-1873. With maps. pp. 1179 and 1237. 8vo.

Tables and Formulæ. Revised edition. Professional Papers, Corps of Engineers, U. S. A., No. 12. Washington, 1873. pp. 319, 8vo.

Geological Report of the Exploration of the Yellowstone and Missouri Rivers. By W. F. Raynolds and F. V. Hayden. 1859-1860. Washington, 1869. With map. pp. 183, 8vo.

Report upon the so-called Yellowstone Expedition of 1870. By Augustus C. Doane. Washington, 1873. pp. 40, 8vo.

Report upon Experiments made by W. H. Hearding upon the Compressive Power of Pine and Hemlock Timber, Feb. 6, 1871. By D. C. Houston. Washington, 1872. With map. pp. 42, 8vo.

Reconnaissance in the Ute Country, 1873. By E. H. Ruffner. Washington, 1874. With a map. pp. 101, 8vo.

Stability of Arches. By D. P. Woodbury. New York, 1858. With plates. pp. 438, 8vo.

Reconnaissance of the Yukon River, 1869. By Charles W. Raymond. Washington, 1871. With map. pp. 113, 8vo.

Exploration of the Yellowstone River by W. F. Raynolds, communicated by the Secretary of War. Washington, 1868. With map. pp. 174, 8vo.

Fabrication of Iron for Defensive Purposes. Washington, 1871. With plates. pp. 233, 4to. Supplement, 1872. With plates. pp. 51, 4to.

Iron Lock Gates, Weser River, Germany. Translation. By G. Wel'zel. Washington, 1873. With plates. pp. 8, 4to.

Effects of Sea Water and Exposure upon the Iron-pile Shafts of the Brandywine-Shoal Light House. By John D. Kurtz and Micah R. Brown. Washington, 1874. With plates. pp. 15, 4to.

Potomac Aqueduct of the Alexandria Canal, 1835-1840. By William Turnbull. Washington, 1873. With plates. pp. 49, 4to.

Defenses of Washington. By J. G. Barnard. Washington, 1871. With plates. pp. 152, 4to.

Geological Exploration of the Fortieth Parallel. By Clarence King. Washington, 1870. Vol. III, with plates and atlas. pp. 647. 1871. Vol. V, with plates. pp. 525, 4to.

Use of the Barometer on Surveys and Reconnaissances. By R. S. Williamson. New York, 1868. Two parts. With plates and Appendix. pp. 248 and 155, 4to.

North Sea Canal of Holland and Improvement of Navigation from Rottendam to the Sea. By J. G. Barnard. Washington, 1872. With plates. pp. 77, 4to.

Preliminary Report.—Explorations in Nevada and Arizona. By G. M. Wheeler. Washington, 1872. With maps. pp. 96, 4to.

Removal of Blossom Rock, San Francisco Harbor. By R. S. Williamson and W. H. Heuer. Washington, 1871. With plates. pp. 40, 4to.

MAPS.—*Western Territories, etc. U. S. Military Map; New Mexico and Arizona; Texas, Kansas, etc.; Yellowstone and Missouri Rivers; Nebraska and Dakota; Indian Territory; South and Southeastern Nevada; Yellowstone Lake, etc., etc.*

The Land and Fresh-water Shells of La Salle County, Ill. By W. W. Calkins. Chicago, 1874, pp. 48. 8vo.

Annales Academici-Lugduni-Batavorum, 1868-1869. pp. 475. 1869-1870. pp. 268, 4to.

Transactions of the Zoological Society of London, 1874. Vol. VIII, Part 7. 4to.

Proceedings of the Zoological Society of London, 1873. Part III, with illustrations. pp. 625-862, 8vo.

Oversight over det Kongelige Danski Videnskabernes Selskabs Forhandlinger og dets Medlemmers Arbejder i Aaret 1873. L'Academie Royale de Copenhague, No. 2. With plates. pp. 248, 8vo.

Nomenclator Avium Neotropicalium. Phillippo Lutley Sclater et Osberto Salvin. London, 1873. pp. 171, 4to.

British Marine Algæ. By W. H. Grattann. London, W. C., 1874. Part X, illustrated. pp. 219-237, 8vo.

Annual Report of Department of Natural History. Northwestern University. By Oliver Marcy. Chicago, 1873. pp. 11, 8vo.

Report by the Curators to the Governor. University of the State of Missouri. Saint Louis, 1874. With plates. pp. 188, 8vo.

Iowa State Report on Insects. By C. E. Bessey. Des Moines, 1874. With plates. pp. 23, 8vo.